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INVERTEBRATE FAUNA OF THE INTERTIDAL ZONE OF THE TOKARA ISLANDS

VII. ASCIDIANS[1)2)]

(Contributions to Japanese Ascidian Fauna. VII)

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With Plates XVIII–XXXVII and 2 Text-figures

The material of ascidians collected in the Tokara Islands consists of the following 25 species and 2 forms, of which 13 species seem to be new to science and 4 species with asterisk are newly recorded from the Japanese waters. Thus the Tokara collection contributed a big addition to Japanese ascidian fauna.

	Takarazima	Nakanosima
1. *Polyclinum tsutsuii* n. sp.	+	
2. *Aplidiopsis tokaraensis* n. sp.	r	
3. *Amaroucium monotonicum* n. sp.	rr	
4. *Didemnum* (*Didemnum*) *moseleyi*	+	+
4a. *Didemnum* (*Didemnum*) *moseleyi* f. *granulatum* nov.	+	
4b. *Didemnum* (*Didemnum*) *moseleyi* f. *punici-color* nov.		+
*5. *Didemnum* (*Didemnum*) *candidum*	+	
*6. *Didemnum* (*Didemnum*) *pulvinum* nom. nov.	+	rr
*7. *Lissoclinum fragile*	rr	
8. *Leptoclinum mitsukurii*	rr	
9. *Leptoclinum midori* n. sp.	rr	cc
10. *Podoclavella polycitorella* n. sp.	+	
11. *Eudistoma snakabri* n. sp.	r	
12. *Eudistoma rubra* n. sp.	rr	r
13. *Eudistoma tokarae* n. sp.	rr	
14. *Polycitor proliferus*	+	+

1) Scientific Survey of the Tokara Islands, Report No. 8.
2) Contributions from the Seto Marine Biological Laboratory, No. 222.

15.	*Perophora listeri* var. *tokarae* nov.	rr	
16.	*Perophora formosana*	+	+
17.	*Ecteinascidia tokaraensis* n. sp.	r	
18.	*Ecteinascidia jacerens* n. sp.	rr	
*19.	*Ascidia aperta*	c	
20.	*Ascidia beta* n. sp.		rr
21.	*Botrylloides violaceum*	r	
22.	*Polycarpa takarazima* n. sp.	r	
23.	*Cnemidocarpa areolata*	rr	
24.	*Styela partita*	r	
25.	*Microcosmus curvus* n. sp.	r	r
Number of species		24 species+ 1 form	8 species+ 1 form

It is needless to say that most of the species listed above are tropical ascidians. The most abundant and impressive species are *Ascidia aperta* of Takarazima and *Leptoclinum midori* of Nakanosima which is, as far as I am aware, the northern-most locality of the tropical ascidians harbouring green zoochlorellae in the colony. There are much more species in Takarazima than in Nakanosima; this fact may be attributable to the degree of the development of the coral reef around the island. It is rather questionable whether the circumstances are more tropical in Takarazima than in Nakanosima so that much more ascidians are reservoired in the former.

1. *Polyclinum tsutsuii* n. sp.

(Pl. XVIII, Figs. 1–3; Text-fig. 1)

Many encrusting colonies (Type 127, TK. No. 68) were found aggregated under stones at the western side of Maégomori in Takarazima, the largest one of which is 20 mm × 15 mm in extent. They are 3–4 mm in thickness and dark brownish in colour. Stellate systems distinct, each consists of 4–12 zooids, most frequently 6–8, and has a round common cloacal aperture at the centre. Large colonies contain up to 9 large and small systems.

Test: Transparent, grayish brown in colour. The surface quite free from foreign matters.

Zooid: Large zooids reach 4.5 mm in length, of which 3.5 mm is for thorax and 1 mm for abdomen. Postabdomen about a half as long as abdomen and protruded from the left side of the intestinal loop posterior to the stomach. Constriction between the thorax and the abdomen and that between the abdomen and the postabdomen are both distinct.

Thorax: Branchial aperture 6-lobed; atrial aperture situated on the level of the peripharyngeal band and margined plainly. Atrial languets well developed, tip acute or truncate and with 4–6 teeth; the latter feature is observable when the languet reaches the common cloacal aperture, while the former feature occurs when the languet falls at a distance from the aperture. About 10 longitudinal muscles on the dorsal half on each side. Rows of stigmata 11–12, rarely 10; each comprising 20–25 elongate stigmata. Two or three muscle fibres along each transverse vessel which bears many papillae as shown in Fig. 1. Tentacles slender and 23 in an examined zooid, comprising large and small ones. Ciliated groove a small oval opening. Dorsal languets considerably long and slightly displaced to the left side from the dorso-median line. Anus bilobed and situated on the level of the transverse vessel from 5th to 6th.

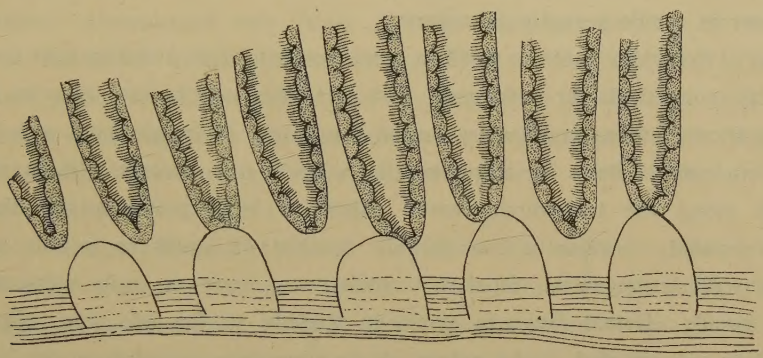

Fig. 1. *Polyclinum tsutsuii* n. sp. A part of the branchial sac, showing papillae on the transverse vessel, ×200.

Abdomen: Alimentary canal lies almost horizontally. Stomach large and globular, situated slightly in front of the middle of the abdomen; the surface smooth. Mid-intestine distinct and constricted from the rectum before the canal reaches the posterior end of the abdomen. No coecum at the proximal end of the rectum. A distinct bend of rectum is found on the level of the hind-stomach.

Postabdomen: Club-shaped. Ovary is situated at the proximal part and contains several small ova, testis occupies the distal part and consists of 8–14 testicular follicles.

2. *Aplidiopsis tokaraensis* n. sp.

(Pl. XVIII, Fig. 4; Pl. XIX, Figs. 1–3)

Five colonies (Type 128) in the material from Takarazima, the largest one of which is 14 mm×9 mm in extent and 8 mm in height. They are roughly cubical in

shape and attached to the substratum by the underside. They carry white sand grains over the surface; consequently, neither system nor common cloacal aperture can be discerned with certainty. Some slight grooves and lobations may occur on the surface of colonies.

Test: Very soft, milky white in colour and translucent. Sand grains adhere merely to the surface, but never embedded in the test.

Zooid: About 3.5 mm in length in fully expanded state. Thorax and abdomen roughly equal in length in contracted state; the latter usually situated vertically in thicker parts of the colony, but frequently it may be bent horizontally in thinner parts of the colony as shown in Pl. XIX, figs. 2 and 3. Constriction between the thorax and the abdomen inconspicuous. Postabdomen is a slender sac protruded from the left side of the intestinal loop near the posterior end of the abdomen. It is very short in zooids sexually immature.

Thorax: Branchial aperture 8–(7 in some zooids) lobed, atrial languet terminates in a bluntly pointed, bi- or trifid end. Ten to twelve longitudinal muscles on each side of the thorax; these muscles are united into a pair of longitudinal muscle bands along the abdomen. Rows of stigmata 12–13, each row contains 18–20 stigmata. No papilla along the transverse vessel. About 8 large tentacles are discernible distinctly, probably besides a considerable number of small or minute tentacles alternating with larger ones. Smaller tentacles are, however, quite indiscernible in contracted zooids. Dorsal languets displaced slightly to the left side. Anus with thickened lips and situated at the height of the transverse vessel from 7th to 8th.

Abdomen: Stomach occupies a large part of the abdomen near the middle, elongate oval in outline and smoothly surfaced. Distinct constriction between the mid-intestine and the rectum at the posterior end of the abdomen, no coecum at the proximal end of the rectum. Gonads in postabdomen are immature.

3. *Amaroucium monotonicum* n. sp.

(Pl. XIX, Figs. 4–5; Pl. XX, Fig. 1)

Eleven colonies (Type 129) in the material from Takarazima. They are small, mushroom-shaped, about 3 mm in diameter and ca. 2 mm in height; usually stand erectly, although some colonies are lying obliquely. Each colony contains only a single system usually consisting of 6–7 (from 4 to 8) zooids surrounding a round common cloacal aperture at the centre.

Test: Soft and nearly transparent. The surface is smooth and holds no foreign matter.

Zooid: About 1.5 mm in length. Abdomen is slightly shorter than the thorax

in contracted state. Postabdomen as long as the abdomen. No constriction between the abdomen and postabdomen. Thorax orange red in colour when alive.

Thorax: Branchial aperture 6-lobed, atrial aperture round and with an atrial languet, the tip of which is undivided in some zooids, while it is bi- or trifid in others. About a dozen longitudinal muscles on each side of the thorax. Rows of stigmata 6, the number of stigmata in each row can not be given here definitely on account of rather strong contraction occurred on all zooids, though about 10 stigmata are esteemed in a row. Number of tentacles is also obscured by contraction, although about a dozen ones are esteemed. Dorsal languets distinct. Anus situated on the level of the 4th transverse vessel and surrounded with 2 lips. Embryos and eggs in various stages of development, up to 9 in all, are incubated in the dorsal side of the right peribranchial cavity.

Abdomen: Oesophagus very short. Stomach large and globular, situated slightly in front of the middle of the abdomen in contracted zooids and with 16–18 distinct longitudinal plications on the wall. Hind-stomach passes to the mid-intestine at the posterior end of the abdomen. No coecum at the proximal end of the rectum.

Postabdomen: Two mature eggs at the proximal end of the postabdomen. Testicular follicles arranged in two rows.

Larva: Trunk elliptical, 410 μ in length; width/length is 0.54. Attachment processes cup-shaped and arranged linearly. Three finger-shaped bulbs, each ending in a rounded tip, are situated at the base of the attachment processes. In an examined larva, 5 small vesicles were found at the antero-dorsal and 10 ones at the antero-ventral part of the trunk. Two sensory pigment flecks arranged antero-posteriorly or obliquely. Larval test strongly granulated.

Remarks: It is the most remarkable characteristic of this new species, that each colony has merely a single system; hence the present nomenclature is derived.

4. *Didemnum* (*Didemnum*) *moseleyi* (HERDMAN), 1886

(Pl. XX, Figs. 2–7)

Many colonies (TK. Nos. 69–70) were collected in both Takarazima and Nakano-sima. As the structure of zooids is quite invariable in many species of *Didemnum* (*Didemnum*), we are often obliged to place reliance on the appearance of the colony and the shape of the spicules when many specimens of *Didemnum* are submitted to us for identification. However, the characteristics, mentioned above, vary so widely that the distinction of species is very hard and thus it is required to establish some provisional species or forms for convenience' sake to record the material, although some confusions may occur by the increase of names.

In the present case, there are two groups of colonies in the material of white-coloured *Didemnum*: one is undoubtedly *Didemnum* (*Didemnum*) *candidum* SAVIGNY and the other is a form containing in the test calcareous spicules which are larger than those of *Did.* (*Did.*) *candidum* and bear fewer rays on the equatorial plane. It is well known that spicules of the former show a considerably wide range of variation in size and appearance (cit.: VAN NAME 1945: Bull. American Mus. Nat. Hist., Vol. 84, pp. 83–86) and the shape and appearance of spicules in the latter are considered to be in the range of variation found in the former. But, at present, it is also an evident fact that there is not found any intermediate form between the two forms at least in the present material. Thus, I prefer to record here the latter under the name of *Did.* (*Did.*) *moseleyi* HERDMAN and to give some figures as materials for future studies.

Specimens from Takarazima: All colonies white. The largest one is 20 mm × 40 mm in extent, less than 1 mm in thickness. Distance between zooids usually 650 μ. Spacious lacunae only in the thoracic layer. The surface of colonies even, no common cloacal aperture is found in any specimen. Spicules distributed densely and evenly from the bottom to the surface very near the superficial layer. They are rather large, usually 40 μ in diameter, and may reach 48 μ in larger ones. Ten to twelve rays on the equatorial plane. Thorax less than 400 μ in a contracted state, abdomen up to 550 μ in length. Testicular follicle 1, proximal end of vas deferens coils 6–7 times. Trunks of embryos found in a colony ca. 400 μ in length, width/length ca. 0.5. Two sensory pigment flecks arranged dorso-ventrally in some examined larvae. The observation on a small number of specimens seems, however, to be of no important significance, because the arrangement of pigment flecks can be often shown in different appearances as described below on *Did.* (*Did.*) *candidum* (p. 246).

Specimens from Nakanosima: Spicules smaller than in the preceding specimens, 26 μ in the average and 32 μ in the maximum diameter; 8–12 rays on the equatorial plane.

4*a*. *Didemnum* (*Didemnum*) *moseleyi* f. *granulatum* nov.

(Pl. XXI, Figs. 1–4)

A considerable number of small and thin colonies (Type 130) in the material from Takarazima. Colony white in colour, common cloacal apertures oval in outline, few and small. The surface is densely covered with small (ca. 100 μ in diameter) ovoid protuberances which are nothing but accumulated spicules and give the surface a coarse granulated appearance. The arrangement of lacunae and the distribution of spicules are quite the same as in the typical form. Spicules usually 32 μ in

diameter, 52 μ in the maximum. About 10 rays on the equatorial plane.

Zooid: Distance between zooids 580 μ on an average. Each the thorax and the abdomen ca. 500 μ in length. Retractile muscle of moderate length. Testicular follicle 1, the proximal end of vas deferens coils 5–6 times.

Larva: Length of trunk 280 μ, width/length 0.66. Sensory pigment flecks arranged antero-posteriorly.

Remarks: The present form represents merely a granulated *forma* of *Did.* (*Did.*) *moseleyi*, because there are many intermediate states between the plain surface and the granulated one. I prefer to place here the present specimens under *Did.* (*Did.*) *moseleyi* on account of the close resemblance of the shape of calcareous spicules, although it is not impossible that the present form belongs to *Did.* (*Did.*) *candidum*. The larva seems too small for *D. moseleyi*, but fits to *D. candidum*.

4*b*. *Didemnum* (*Didemnum*) *moseleyi* f. *punici-color* nov.

(Pl. XXI, Fig. 5; Pl. XXII, Figs. 1–3)

A considerable number of small colonies (Type 131) from Nanatuyama Ura of Nakanosima. The largest one 17 mm×12 mm in extent; usually 1 mm in thickness, but rarely thicker at some places of the colony. The colony is pinkish when alive, but soon fades to white in preservation. The arrangement of lacunae is quite the same as in the typical form. The surface smooth. Spicules distributed densely and evenly from the bottom to the surface very near the superficial layer except for the small part above each zooid, where they are very sparse, aggregated merely along six lobes of the branchial aperture and thus the outline of the aperture is shown clearly on somewhat dark background. Spicules 32 μ on the average and 38 μ in the maximum diameter. Eight to twelve rays on the equatorial plane, each ray ends in a bluntly pointed tip or rarely nearly truncate distally in smaller spicules.

Zooid: Average distance between zooids 680 μ. Thorax ca. 620 μ in an expanded state, abdomen ca. 600 μ in length. A small thoracic tubercle is found in the posterior half of the thorax on each side and contains some minute spicules in it. Retractile muscle rather long, muscles taken out wholly up to 1.2–1.6 times the length of the contracted thorax. A part of fibres of the retractile muscle proceeds anteriorly along the dorso-median line of the branchial sac. The boundary between the pyloric portion of stomach and the hind-stomach indistinct, while the mid-intestine distinct. Testicular follicle 1, the proximal end of vas deferens coils ca. 5 times.

Remarks: The pinkish hue occurs so constantly and on so many colonies collected in a wide area, that I am inclined to consider the present form as a distinct species. Somewhat long retractile muscle and the characteristic distribution of spicules above

zooids seem to encourage this idea. It is obvious, however, that more crucial studies, especially the statistical analyses and the close observations on various developmental stages, are required to settle the problem. Here, I can only record the present form provisionally under *Did.* (*Did.*) *moseleyi*.

5. *Didemnum* (*Didemnum*) *candidum* SAVIGNY, 1816

(Pl. XXII, Figs. 4–6; Pl. XXIII, Figs. 1–7)

Many colonies (TK. Nos. 71 and 72) from Takarazima, the largest one of which is 10 mm×12 mm in extent. Colonies very thin, less than 1 mm in thickness and usually white in colour. Surface even; common cloacal apertures not numerous and oval in outline. The arrangement of lacunae as in the preceding species. Spicules are densely and evenly distributed in most of colonies. They are usually about 30 μ in diameter, although the maximum diameter may reach up to 46 μ. Rays numerous, short and bluntly tipped and about 20 in number on the equatorial plane.

Zooid: Thorax ca. 310 μ in strongly contracted state, abdomen ca. 500 μ in length. Retractile muscle of a moderate length. Branchial aperture distinctly 6-lobed. Thoracic tubercle a low elongate prominence near the ventro-posterior corner of the atrial aperture on each side of the thorax. Testicular follicle 1, proximal part of vas deferens coils 4–5 times.

Larva: Trunk 270–330 μ in length, ca. 290 μ on an average; width/length 0.6–0.7. Attachment processes 3 and arranged linearly; rarely they may be 2 or 1 in number or arranged in a triangle. Two sensory pigment flecks arranged most frequently antero-posteriorly, although they may be situated obliquely or dorso-ventrally in some larvae. For instance, among 45 examined larvae, 28 with antero-posteriorly arranged pigments, 15 with obliquely arranged pigments and 2 with dorso-ventrally arranged pigments. Among 20 examined larvae from a colony, 15 with three attachment processes, 3 with two processes and 2 with a single process.

Remarks: There are two groups of specimens which bear somewhat different appearances from that of the typical form mentioned above. The one contains two pinkish colonies from Takarazima. They are respectively 5 mm×7 mm and 4 mm×5 mm in extent and less than 1 mm in thickness. An oval common cloacal aperture, ca. 0.3 mm in long axis, at the centre of each colony. The surface is sprinkled sparsely with minute prominences each formed by aggregated spicules. Spicules ca. 30 μ in diameter, consist of many small and short rays and distributed densely and evenly from the bottom to the surface. Zooids rarely with retractile muscle of a considerable length.

The other consists of a few colonies, of which the largest one is 10 mm×28 mm

in extent and ca. 1 mm in thickness. Colonies pale purplish gray in colour when alive. Zooids distributed evenly in the colony. The surface of the colony is raised around the branchial aperture of each zooid and appears uneven when observed under low magnification. Spicules very sparse, consequently the test is so translucent that yellowish-brown zooids can be seen through. Superficial spiculeless layer very distinct. Spicules are most densely aggregated along the floor of the lacunae, but they are quite missing in the bottom layer which is somewhat milky white. They are ca. 27 μ in diameter, very rarely up to 45 μ. Spindle cells in the transparent part of the test contain each 10–20 granules (Pl. XXIII, fig. 5). Thorax ca. 800 μ in an expanded state, large abdomen 730 $\mu \times 680\ \mu$ and neck of a considerable length. Retractile muscle not long. About 7 stigmata in a row, dorsal languets long and slender. Anus opens on the level of the 3rd transverse vessel. Both hind-stomach and mid-intestine distinct. Proximal part of vas deferens coils 4½–8 times.

These two forms may be safely admitted as merely variants of *Did. candidum.*

6. *Didemnum* (*Didemnum*) *pulvinum* nom. nov.*

(Pl. XXIII, Figs. 8–10; Pl. XXIV, Figs. 1–5)

Many colonies (TK. No. 73) from Takarazima and a few ones from Nakanosima. Colonies small, the largest one 11 mm × 6 mm in extent; 2–3 mm in thickness. Compared with the size, the thickness is rather large. This is due to the thick hypoabdominal bottom layer which is 1–1½ times as thick as the layer containing zooids. Lacunae around the thorases and also the abdomens and contain numerous zoochlorellae in them. Surface even and coloured marginally white and greenish in central part when alive, but turns to pale yellowish in preservation in alcohol; underside pure white. Common cloacal apertures quite obscure on all examined colonies. Zoochlorellae up to 12 μ in diameter and greenish in colour in fresh state. Spicules rather sparse in the layer containing zooids, while they are found very densely in the bottom layer. There is a thin superficial spiculeless layer. Spicules consist each of very numerous rays short and bluntly tipped. They are usually ca. 30 μ in diameter, but up to 53 μ in larger ones.

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* Changes of names: Dr. A. J. BARFIELD of the British Museum called my attention on two homonyms which were found in my previous work "Ascidians from the Palao Islands I, Publ. Seto Mar. Biol. Lab., I (3) 1950". They are *Didemnum* (*Didemnum*) *gottschaldti* (p. 44) and *Polycarpa simplex* (p. 64). I became aware of the homonymy of the former immediately after the publication, but was quite ignorant of that of the latter. Here, I wish to express my hearty thanks to Dr. BARFIELD for his kind advice and revise these names as follows:

Didemnum (*Didemnum*) *gottschaldti* → *Didemnum* (*Didemnum*) *pulvinum* nom. nov.
Polycarpa simplex → *Polycarpa rubra* nom. nov.

Zooid: Average distance between zooids 480 μ. Thorax 550 μ in an expanded state, abdomen 450 μ including testis and situated horizontally or slightly oblique. Deep constriction between the thorax and abdomen. Many zooids with buds at the oesophageal region.

Thorax: Branchial aperture 6-lobed, lobes rather indistinct; atrial aperture a huge opening extending dorsally near the endostyle. About 7 stigmata in each of 4 rows. Tentacles about a dozen, three dorsal languets distinct. Anus situated on the level of the 3rd transverse vessel and with thickened lips. A pair of strong muscle fibres along the dorso-median line of the branchial sac.

Abdomen: The division of alimentary canal is very indistinct superficially, only the posterior end of the mid-intestine is discernible with difficulties. In transparently prepared zooids, however, an oval gastric region can be observed very clearly. Ovary situated near the cardiac end of the stomach and usually contains an ovum; a single testicular follicle spherical, vas deferens quite straight at the proximal end.

Remarks: There is another stock of colonies (TK. No. 74) collected in Takarazima, the largest one of which is 12 mm×6 mm in extent and usually 1 mm in thickness. They are purplish gray or brownish in colour at places where spicules are sparse and zooids are seen through. The surface even, slightly granulated at places or raised slightly above each zooid. There may occur some shallow irregular grooves on the surface. Lacunae arranged as in the preceding description. Spicules very sparse at many places in the surface layer, but distributed rather densely in the abdominal layer. They may be 50 μ in diameter in larger ones and usually defaced on the surface. Lacunae harbour abundant yellowish or brownish zoochlorellae which are larger than in the preceding specimens, usually ca. 16 μ in diameter, but up to 20 μ in larger ones. Thorax may reach 630 μ in some zooids, while abdomen usually ca. 430 μ in length. These specimens are regarded as colonies with thin bottom layer and harbouring another sort of zoochlorellae or fully grown up and partly yellowing zoochlorellae.

7. *Lissoclinum fragile* (VAN NAME), 1902

(Pl. XXIV, Figs. 6–7; Pl. XXV, Figs. 1–2)

A 20 mm×25 mm wide colony (TK. No. 75) detached imperfectly from the surface of a stone in Takarazima. It is probably 1.5 mm in thickness, the surface is smooth and pure white in colour. The colony consists of two thin layers, surface and bottom layers, and a spacious lacuna between these layers, in which zooids are situated nearly exposing their whole bodies. Abdomen placed on the floor horizontally with its right side upwards. Spicules consist of many short and truncate rays, usually

32 μ in diameter and reach up to 51 μ in larger ones. They are distributed evenly but not much densely.

Zooid: Average distance between zooids ca. 620 μ. Expanded thorax may be twice as long as the abdomen. Branchial aperture 6-lobed. About 7 stigmata in each of 4 rows; tentacles 14, large and small ones alternate regularly; ciliated groove an oval orifice and dorsal languests thin but long. Anus situated on the level of the 3rd transverse vessel. An elliptical thoracic tubercle near the antero-dorsal corner of the atrial opening on each side and contains in it an aggregation of small spicules. The boundary between the hind-stomach and the mid-intestine is clearer than that between the hind-stomach and the pyloric end of the stomach. A large ovum beside the outer edge of the stomach. Testicular follicles 2, proximal end of vas deferens swollen, but not coiled or curved.

Remarks: The present specimen differs from the preceding descriptions of *Liss. fragile* in the appearance of the atrial aperture, but this difference is probably due to the state of contraction. Any atrial languet can not be found on the present material; the anterior part of zooid adheres so tightly to the test that this part can not be taken out without any injury. *Diplosomoides molle* HERDMAN resembles closely the present specimen in the internal structure, but it differs distinctly from the latter in the shape of the colony which is not encrusting but forms a rounded mass in the former (Challenger Report Tunicata II, p. 310).

8. *Leptoclinum mitsukurii* (OKA), 1892

Small fragments from Takarazima, all examined zooids were immature sexually (TK. No. 79).

9. *Leptoclinum midori* n. sp.

(Pl. XXV, Figs. 3–7)

A few colonies (Type 132) from Takarazima and many colonies (TK. No. 76) from Nakanosima. They are usually small, 7 mm×11 mm—10 mm×15 mm in extent in larger ones; 1–3 mm in thickness. The colony coloured green all over and brilliant blue around the branchial apertures when alive. Common cloacal aperture only one in colonies of usual size. Zooids situated with their ventral sides towards periphery. About 110 zooids were counted in a colony 6 mm×8 mm in extent and 2 mm in thickness. Lacunae well developed and contain many zoochlorellae in them; chlorellae up to 18 μ in diameter. Preserved specimens easily lose the brilliancy and fade to a dark greenish tint; cut specimens become soon transparent, because zoochlorellae escape from the colony through the incision.

Zooid: Thorax ca. 500 μ in length, abdomen ca. 640 μ in length including the testis. Usually four buds, large and small pairs of thoracic and abdominal buds, are found in the neck region. Branchial aperture 6-lobed, lobes small; 6 stigmata in each of 1st-3rd rows and 5 in the 4th row. Tentacles 6, dorsal languets small triangular processes. Retractile muscle short. Alimentary canal horizontal. The stomach tapering gradually to the following part of the canal. Fully matured ovum occupies the underside of the intestinal loop (Pl. XXV, fig. 5). Testicular follicles 2, both globular in shape (Pl. XXV, fig. 4).

Remarks: The present species resembles closely *Leptoclinum virens* HARTMEYER, but the latter differs distinctly from the former in the shape of the stomach which is somewhat rectangular in outline and constricted very clearly from the following part of the alimentary canal in the latter. *Midori* means the green colour in Japanese.

10. *Podoclavella polycitorella* n. sp.

(Pl. XXVI, Figs. 1-3)

The present new species seems to be solitary and is considered to bridge between Clavelininae and Polycitorinae. Many individuals (Type 133) were collected in Takarazima. The body elongate, 10 mm long in expanded state and attached to the substratum along the ventral side as shown in Pl. XXVI, fig. 1. The anterior portion of the body grayish green and fades toward the posterior portion where the yellowish orange alimentary canal can be seen through; both apertures and endostyle dark green. This ascidian always contracts so strongly whenever it is detached from the substratum, that it is almost impossible to obtain the expanded specimen even if the animal is treated in some anaesthetics after the collecting. I found merely a single expanded individual in the present material; the following descriptions are chiefly based on this sole specimen.

Test: Thin and soft, nearly colourless and transparent.

Mantle body: Thorax twice as long as the abdomen or more. The constriction between the thorax and the abdomen is not so remarkable.

Thorax: Both apertures indistinctly 6-lobed. Twelve to thirteen longitudinal muscles are running on each side of the thorax and united into a short but strong retractile muscle along the ventro-proximal part of the abdomen. Transverse muscle absent. Rows of stigmata 8, ca. 20 stigmata in each row. No papilla on the transverse vessel. Tentacles about a dozen, including large and small ones, ciliated groove a minute oval opening and seven triangular dorsal languets slightly displaced to the left side. Anus situated on the level of the 4th transverse vessel and with two thickened lips. Immature embryos up to 3 in number were observed in the

right peribranchial cavity at the dorso-posterior portion. In preserved specimens, slightly bluish in colour, especially darker in the anterior part around both apertures.

Abdomen: Less than 1/2 of the length of the thorax even in strongly contracted state. Stomach situated near the middle, nearly spherical in outline and with smooth surface. Mid-intestine distinct, the proximal end of the rectum clearly constricted from the mid-intestine but forms no coecum. Ovary situated at the posterior end of the intestinal loop and contains several ova, testis is contained in a globular process protruded from the side of the intestinal loop and consists of ca. 20 follicles. This process is as large as the stomach and pale bluish in colour. It may be called more adequately "genital sac" than "postabdomen".

Remarks: Independence of each individual seems to place the present new species in Clavelininae, but it does not belong to *Clavelina*, because its stomach has no plication on the wall. Short abdomen, the existence of the genital sac are the characteristics common to the present new species and species in Polycitorinae. It is not impossible that this species represents a solitary form of *Polycitor* or a form of *Polycitorella*, which is solitary and devoid of spicules in the test. Also it is not impossible that I failed to find thin stolons connecting several individuals. Thus, after a long hesitation, I decided to place the present form provisionally under *Podoclavella*.

11. *Eudistoma snakabri* n. sp.

(Pl. XXVI, Figs. 4–5; Pl. XXVII, Figs. 1–5; Pl. XXVIII, Fig. 1)

Incrusting colonies (Type 134) found at Ôse in Takarazima, the largest one 45 mm×60 mm in extent and up to 8 mm in thickness. The surface even but covered with many sand grains except for a few parts of the colony. Sand grains are also embedded in the test, especially densely in the abdominal layer. Test purplish black. System obscured by sand grains.

Zooid: Thorax may reach 3 mm in some contracted specimens; straightly stretched abdomen nearly 6 mm in length, but usually abdomen is bent strongly as shown in Pl. XXVII, figs. 4–5 and about a half as long as the thorax. Brownish orange in colour; stomach orange, the proximal part of the rectum coloured olive, but turns gradually to purplish brown according to approach near the distal part.

Thorax: Both apertures 6-lobed; atrial siphon very distinct, sometimes reach a considerable length (Pl. XXVIII, fig. 1). Twenty to thirty five longitudinal muscles on each side of the thorax, a considerably wide area along each side of the endostyle is devoid of these muscles. Transverse muscles very numerous, ca. 65 were counted in an examined zooid. About 20 long stigmata in each of 3 rows. Tentacles 20–25

including minute ones, two dorsal languets distinct, slightly displaced to the left side. Anus 2-lobed and situated on the level of the 2nd transverse vessel. Usually 1 or 2 embryos in the incubatory portion of the peribranchial cavity.

Abdomen: Oesophagus and rectum very long. Stomach situated in the posterior part, round in outline and without any plication of the wall. Mid-intestine distinct, descending and passes to the rectum slightly in front of the posterior end of the abdomen. No coecum at the proximal end of the rectum. Usually the rectum curves strongly on the level of the stomach; this bend is, however, probably due to the slight contraction of the abdomen. Testis situated in the intestinal loop posterior to the stomach and consists of follicles up to ca. 30 in number, ovary occupies the centre of the testis on the left side and usually a large ovum discernible there. A pair of longitudinal muscle bands along the ventral side on each side.

Larva: Trunk up to 1.2 mm in length, width/length 0.5–0.55. Three attachment processes arranged linearly. Distal end of each process elongate in outline. Many vesicular prominences in the anterior part of the trunk. Yellowish orange as a whole and sprinkled with minute reddish orange pigment spots which are found densely in the anterior part. Larval test frothy.

Remarks: *Eudistoma angolanum* MICHAELSEN resembles closely the present new species in the structure of zooids, especially in abundant transverse muscles on the thorax. The former differs, however, from the latter distinctly in the form and colour of the colony which is roughly hemispherical in shape and is not wholly pigmented in the former. *Snakabri* means the condition covered with sand grains in Japanese (*suna*=sand, *kaburu*=be covered).

12. *Eudistoma rubra* n. sp.

(Pl. XXVIII, Figs. 2–6; Text-fig. 2)

Several colonies from Takarazima (TK. No. 77) and Nakanosima (Type 135). Colonies small, mushroom-shaped and each consists of a single corona and peduncle. For instance, in the largest colony in the present material the corona is 8 mm in diameter and 3 mm in height and the peduncle 5 mm in length. One colony in the material consists of two cormidia. Usually colonies are standing, though some colonies lying or situated obliquely or rarely quite irregular in shape, corona and peduncle being indiscriminative. About twenty zooids counted in a colony, 5 mm in diameter and 4 mm in height. Test of corona soft and quite transparent, pinkish orange thorases and reddish abdomens of zooids are seen through; peduncle yellowish brown, this colouration is due to the existence of faecal pellets which are found most abundantly near the basal portion, but sparsely in the corona around the

thorases or even near the surface. Some colonies pale orange when alive.

Zooid: Thorax 1.3 mm in length, abdomen up to 2.3 mm. Both apertures 6–lobed. Twelve to thirteen longitudinal muscles on each side of the thorax, transverse muscles absent. About 20 elongate stigmata in the 1st row, 12–15 ones in each of 2nd and 3rd rows; the dorsal part of the 1st row runs anteriorly along the dorso-median line as shown in Fig. 2. Tentacles 16, large and small ones alternate regularly; dorsal languets of moderate length. Anus situated on the level of the 2nd transverse vessel.

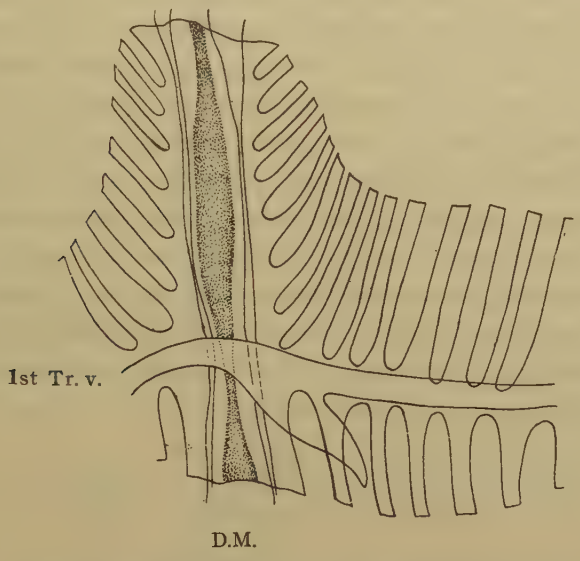


Fig. 2. *Eudistoma rubra* n. sp. Dorso-median part of the anterior portion of branchial sac, ×75.
Tr. v.—transverse vessel, D.M.—dorso-median line.

Two embryos were found in some of the examined zooids. Stomach in the posterior part of the abdomen; mid-intestine distinct, situated at the posterior end of the abdomen horizontally or descending and passes to the rectum at the posterior end of the abdomen, rarely it is constricted from the hind-stomach at the posterior end of the abdomen and ascending. No coecum at the proximal end of the rectum. Gonad immature in all examined zooids.

Larva: Trunk 620 μ in an examined larva, width/length 0.6. Attachment processes cup-shaped and arranged linearly. Three vesicular prominences at the base of the attachment processes on each side. Sensory pigment flecks arranged anteroposteriorly. Larval test frothy.

13. *Eudistoma tokarae* n. sp.

(Pl. XXIX, Figs. 1–2)

Two colonies (Type 136) from Takarazima, they are club-shaped and respectively 6 mm and 4.5 mm in length; the former contains 12 zooids, while the latter 6 zooids. The surface of the corona is slightly raised above each zooid. Test milky white, translucent and sprinkled with minute dark greenish pigment spots. The lower part of the peduncle contains faecal pellets.

Zooid: Thorax 730 μ long in somewhat contracted state, abdomen up to 1.5 mm in length in slightly contracted state. The thorax is sprinkled with minute dark greenish pigment spots which are distributed densely in the anterior part and along the endostyle, especially remarkably at the dorsal ganglion and the anterior end of the endostyle. Both apertures 6–lobed, atrial siphon of considerable length in some zooids. About a dozen longitudinal muscles and about 30 transverse muscles on each side of the thorax, the latter converge dorsally into ca. 7 bundles. Anus with thickened lips and situated on the level of the 2nd transverse vessel. Stomach in the posterior portion of the abdomen, mid-intestine descending and passes to the rectum at the posterior end of the abdomen. No coecum at the proximal end of the rectum. All examined zooids immature sexually.

14. *Polycitor proliferus* (OKA), 1933

Many colonies were found commonly in both Takarazima and Nakanosima (TK. No. 78).

15. *Perophora listeri* var. *tokarae* nov.

(Pl. XXIX, Figs. 3–5)

A few individuals (Type 137) from Takarazima. They are very small, 2 mm in length and connected with the stolon at the postero-ventral part of the body. Test thin and transparent. About a dozen short longitudinal muscles at the antero-dorsal part of the body on each side, they are all converged to the branchial aperture. Muscles on each side are not continuous with each other directly.

Branchial sac: Four rows of stigmata. Inner longitudinal vessels quite absent, although supporting papillae remain in their natural appearance. Papillae somewhat elongate. Six large and six small tentacles alternate regularly.

Length of individual	Tentacle	Stigmata in each row	Longitudinal rows of papillae		Remarks
			Left	Right	
1.8 mm	6	14	5	5	immature
2 mm	12	13	5	6*	mature

* The 5th (ventral-most) row incomplete.

Alimentary system: Stomach globular and situated behind the branchial sac. Mid-intestine distinct, the proximal end of the rectum forms two pairs of small coeca. The second intestinal loop very shallow. The anterior end of the intestinal loop reaches near the 2nd transverse vessel. Anus plainly margined and situated on the level of the 3rd transverse vessel.

Gonad: Testicular follicles 2, ovary situated at the proximal end of vas deferens and consists of several ova.

Remarks: The present specimens differ from the type form of *Perophora listeri* in the number of the longitudinal rows of papillae, which are 8–9 on each side in the latter from the Palao Islands. Moreover, the former lack the inner longitudinal vessels completely. *P. sagamiensis* TOKIOKA also resembles the present specimens, but differs distinctly from the latter in the following two points; testicular follicle 1 and the longitudinal rows of papillae 10 on each side in the former. Thus, it seems to me most reasonable that the present specimens are treated here provisionally as a variety of *P. listeri*, because of the complete absence of the inner longitudinal vessels and the fewness of the papillae on each transverse vessel.

16. *Perophora formosana* (OKA), 1931

A considerable number of specimens were collected in both Takarazima and Nakanosima (TK. Nos. 80 and 81). The largest individual 3.5 mm in length.

17. *Ecteinascidia tokaraensis* n. sp.

(Pl. XXX, Figs. 1–5)

Several individuals from Takarazima (Type 138). The body is ovoid in outline, less than 7 mm in length; usually erect but sometimes lying obliquely. The animal attached to the substratum by the postero-ventral part of the body or a considerably wide area of the left side of the body. Test quite transparent, thin and delicate. About 15 transverse muscles on the dorsal side of the mantle body behind the atrial aperture. They are divided into anterior and posterior groups, muscles of the former encircle the atrial aperture, while those of the latter run straightly towards the

ventral side. Several muscles are issued from the anterior base of the atrial siphon towards the postero-ventral side. Ventral part of each muscle ramified into 2–5 branches falling in far distance from the endostyle. Stolon issued from the body near the posterior end of the endostyle on the level of the proximal end of the rectum. Branchial aperture 8-lobed, atrial aperture 9-lobed and situated on the level of the 2nd or 3rd transverse vessel.

Branchial sac: Eleven to thirteen rows of stigmata, for instance 11–11 or 12–13; 45–50 elongate stigmata in each row. Thirteen inner longitudinal vessels on each side, the dorsal-most of which incomplete and represented by a row of papillae, the next vessel is partly incomplete and rarely the ventral-most one is also partly incomplete. The vessel is supported by triangular processes at the ventral base of a small papilla at the apex of each process. Tentacles ca. 20 including large and small ones, besides several minute ones; each tentacle very slender. Ciliated groove an oval orifice. Dorsal lamina low membrane, a minute intermediate languet between ordinary languets at some places.

Alimentary system: Anterior margin of the intestinal loop reaches the 6–7th transverse vessel. Anus with plain margin and situated on the level of the 5–6th transverse vessel. The second intestinal loop wide and deep, the axis passes in front of the oesophagus. Stomach elongate, without any crest or plication on the surface; its posterior margin hardly beyond the posterior border of the branchial sac. Distinct constriction between the rectum and the mid-intestine.

Gonad: Many testicular follicles arranged in the 1st intestinal loop in the shape of ∩ surrounding the ovary which consists of 20–30 small ova.

18. *Ecteinascidia jacerens* n. sp.

(Pl. XXX, Figs. 6–8; Pl. XXXI, Figs. A–B; Pl. XXXII, Fig. 1)

Three individuals (Type 139) from Takarazima, less than 3 mm in length. The animal lying and attached to the substratum by the left ventral side of the body. A vessel issued from the body near the posterior end of the endostyle, but it is not clear whether this vessel is a stolonial vessel or one running into the test. The body roughly oval in outline. Branchial aperture subterminal and dorsal, atrial aperture near the middle of the body on the level of the 3rd row of stigmata; both apertures nearly plainly margined, though slightly sinuous; the branchial 16-lobed in some individuals. Test delicate, thin and transparent. Many delicate muscles only on the right side, they consist chiefly of transverse or oblique ones.

Branchial sac: Seven-eight rows of stigmata on the right side, eight rows on the left side; the 1st and 7th transverse vessels are not well developed and remain

in the state of the parastigmatic vessel in some individuals. Fifteen to twenty stigmata in a row. Some stigmata of the 1st and 2nd rows and those of the 7th and the 8th rows are often continuous with each other. Inner longitudinal vessels 8 (left)–9 (right) in an individual (A), while they are 11 in other one individual (B). One or two stigmata in a mesh. In the individual (A) the dorsal-most and the ventral-most vessels on the left side and the ventral-most one on the right side are incomplete, while in the individual (B) two dorsal and the ventral-most vessels on the right side and two dorsal and two ventral ones on the left side are incomplete. Fourteen to nineteen slender tentacles including large and small ones. Ciliated groove an oval orifice. Dorsal languets less than 6; the languet on the 1st transverse vessel minute or missing in some individuals, quite absent on the 7th transverse vessel. They are elongate triangular in shape.

Alimentary system: The anterior margin of the intestinal loop reaches the 4th transverse vessel or slightly beyond it. The 2nd intestinal loop wide and deep enough, the axis passes through the anterior opening of the oesophagus to the branchial sac. Stomach nearly globular or slightly elongate; two slight plications may occur on each side in some individuals, the posterior margin slightly beyond the posterior edge of the branchial sac. Mid-intestinal region discernible. In an individual a number of small round bodies were observed around the stomach as shown in Pl. XXXI, fig. B. Anus plainly margined and situated near the level of the 4th transverse vessel. Gonads immature in all individuals.

Remarks: *Ecteinascidia tortugensis* PLOUGH and JONES is a related species, but it has much more rows of stigmata, 18 in number. Some possibilities that the present form does not represent a distinct species but merely an earlier stage of some *Ascidia*, probably *Ascidia aperta*, can not be neglected here.

19. *Ascidia aperta* SLUITER, 1904

(Pl. XXXII, Figs. 2–8; Pl. XXXIII, Figs. 1–4)

SLUITER, C. Ph. (1904): Siboga-Exped., Monogr. LVIa, pp. 38–39, Taf. II fig. 4, Taf. VI figs. 1–5.
VAN NAME, W. G. (1918): U. S. Nat. Mus. Bull. 100, Vol. 1, Pt. 2, pp. 119–121, figs. 75–76.

This ascidian is found commonly in Takarazima under stones in pools or in small crevices on the reef (TK. Nos. 82–85). Individuals found in crevices are usually oval in outline, smaller in size and coloured deep red in the anterior half and somewhat greenish in the posterior half, while those found under stones are somewhat elongate, larger, up to 53 mm in length and 26 mm in width, and coloured much palely. They are milky white, faintly yellowish or reddish orange in the anterior

part of the body near the branchial aperture.

The animal attached to the substratum by the whole left side. Branchial siphon terminal and short, short atrial siphon at the middle of the body or slightly in front of it. In smaller individuals, especially those found in crevices, the atrial siphon directed anteriorly and prolonged till the atrial aperture comes near the branchial aperture. The surface quite smooth and free from the foreign matters. Individuals collected from crevices or basal parts of corals are frequently holding some fragments of corals or shells at some parts of the surface.

Test: Soft gelatinous or cartilaginous, thin and quite transparent. In preserved specimens it is yellowish white and slightly roughened on the surface.

Mantle body: Mantle thin, the right side is wholly reticulated with thin muscle fibres, of which the transverse ones are developed better than the longitudinal ones. The branchial aperture 8–10 lobed, the atrial 8–11 lobed; lobes without pectination. Dorsal ganglion apart from the base of the branchial siphon 1/3–1/2 of the distance between the bases of both siphons.

Branchial sac: Number of tentacles 43 in a 28 mm long individual, while up to 87 in a 53 mm long individual, besides a considerable number of minute ones. Ciliated groove simple crescent in form, apart from the dorsal ganglion about the length of the ganglion.

Body length	Longitudinal vessels	Transverse vessels
46–53 mm (3 ind.)	30–37 ~ 35–39	80–99
28–30 mm (2 ind.)	28–33 ~ 30–32	56–66

Plications distinct in large individuals, 6–12 stigmata in a mesh. About three thinner transverse vessels between each pair of thicker ones. Intermediate papillae present. Dorsal lamina ribbed, distal ends of ribs project beyond the margin of the lamina.

Alimentary system: The anterior end of the intestinal loop never beyond the middle of the base of the atrial siphon. The second intestinal loop extremely shallow, its axis passes through the oesophagus or in front of it; practically absent in some specimens (Pl. XXXIII, fig. 4). Oesophagus opens to the branchial sac slightly in front of the posterior end of the branchial sac. Stomach spherical in outline and usually with 1–2 irregular ridges on each side (up to 5 in total). The distal part of the rectum becomes thinner. Anus bilobed, each lobe plainly margined, and opens near the level of the anterior end of the 1st intestinal loop.

Gonad: Ovary consists of a tubular organ running along the middle part of the 1st intestinal loop and issues 8–10 branches spreading on the inner side of the

intestine and sometimes ramified again into a few short branches; oviduct straight or has a remarkable bend at the middle of its course. Testicular follicles minute, whitish in colour and spread on the inner side of the intestine, extending from the pyloric portion of the stomach to the middle of the intestine. In some individuals many concentric yellowish brown bodies of unknown nature are found in the frothy tissue covering the alimentary canal from the stomach to the distal end of the gonad.

20. *Ascidia beta* n. sp.

(Pl. XXXIV, Figs. 1–5)

A small, 8 mm long×3 mm wide, individual from Nakanosima (Type 140). The body elongate oval in outline, attached to the substratum by the whole left side. The surface even and carries no foreign matter. Branchial aperture subterminal, atrial aperture at the middle of the body; both apertures sessile. Test soft and quite transparent.

Mantle body: 5 mm in length. The right side is wholly reticulated complexly with muscle fibres. Branchial aperture 10 (?) and atrial aperture 8 (?)–lobed. Dorsal ganglion near the middle of the distance between both apertures.

Branchial sac: Tentacles ca. 25 in all, including long and short ones. Ciliated groove simple transverse groove slightly concave anteriorly and apart from the dorsal ganglion about the length of the ganglion. Plications absent. Longitudinal vessels 27 (left)–33 (right), transverse vessels ca. 40; 1–2 stigmata in a mesh. Papillae very small, intermediate papillae absent. Dorsal lamina ribbed, distal ends of ribs beyond the margin of the lamina.

Alimentary system: The anterior margin of the intestinal loop on the level of the anterior side of the atrial aperture. The 2nd intestinal loop narrow and deep, the axis passes through in front of the cardiac end of the stomach which is somewhat elongate in form and without any plication on the surface. Oesophagus opens to the branchial sac at the dorso-posterior corner of the body. Slight constriction between the rectum and the short mid-intestine. Anus plainly margined and situated slightly posterior to the anterior margin of the 1st intestinal loop. Gonad immature.

21. *Botrylloides violaceum* Oka, 1927

Many fragments from Takarazima (TK. No. 89), all purplish brown in colour. There are two colonies, each covering the carapace of *Cryptodromia* sp., they are respectively 16 mm×20 mm and 16 mm×22 mm in extent and both 2 mm in thickness. Zooids up to 2.5 mm in length, erect in thicker colonies, but lying in thinner colonies

which may be only 1 mm thick in preserved state. Rows of stigmata usually 12 (11–13), stigmata arranged D. 5. 3–4. 3. 3–4. V. Anus situated most frequently on the level of the 9th transverse vessel, rarely 8th or 10th. Plications on the stomach usually 9 (rarely 8), besides a small one representing typhlosole. There are one small colony (TK. No. 90) coloured reddish brown and two small colonies (TK. No. 91), respectively 10 mm×6 mm and 8 mm×5 mm in extent, in which zooids are provided with rather fewer rows of stigmata, 9–10. Besides, three small colonies which consist merely of abundant ampullae and contain no developed zooid. These colonies are considered as being in the resting stage before the abrupt growth of the colony, which may be induced by the simultaneous growing of ampullae. The largest one of these colonies is 13 mm×8 mm in extent and 1 mm in thickness.

22. *Polycarpa takarazima* n. sp.

(Pl. XXXIV, Figs. 6–9; Pl. XXXV, Figs. 1–3)

Several individuals (Type 141) from Takarazima, the largest one of which is 13 mm in length. Body slightly elongate, attached to the substratum by the left ventral part of the body, where the test is extremely thin. Branchial aperture subterminal, atrial aperture near the middle of the body; both apertures sessile.

Test: Soft leathery, of moderate thickness, translucent and milky white to yellowish white in colour. The surface is slightly wrinkled and is adhered sparsely with sand grains.

Mantle body: Mantle of moderate thickness and pale grayish brown or pale greenish brown in colour; greenish colouration is remarkable around the apertures. Branchial siphon terminal or subterminal. Both siphons very short and 4-lobed. Many endocarps on the inner surface. Atrial tentacles fine and slender, but placed not so thickly.

Branchial sac: Inner longitudinal vessels arranged as follows:

13 mm long individual:

Left	D.	0	(14)	1	(12)	1	(14)	1	(11)	1	V.
Right	D.	0	(13)	2	(12)	1	(13)	1	(9)	1	V.

12 mm long individual:

Left	D.	1	(10)	2	(8)	2	(10)	2	(8)	1	V.
Right	D.	1	(10)	2	(10)	1	(10)	2	(8)	2	V.

Thicker transverse vessels and thinner ones alternate regularly, parastigmatic vessels present. Stigmata in a mesh less than 7, but up to ca. 10 in meshes along each side of the endostyle. Tentacles ca. 30, including large and small ones, in a

13 mm long individual, ca. 25 in 10–12 mm long individual; frequently they are coloured dark olive brown. Ciliated groove C-shaped, opened towards the right as we face it.

Alimentary system: Alimentary canal occupies the posterior 1/2–1/3 of the left half of the body. The second intestinal loop wide, the axis passes through the middle of the oesophagus. Stomach oval, at least a half as long as the ventral branch of the 1st intestinal loop and with 6–8 distinct plications on each side; plications dark greenish or striped with green and dark brown. Pyloric coecum present, though small. Two or three large endocarps in the 1st intestinal loop, often besides a small one. The free margin of anus finely lobated, 9–10 in all.

Gonad: Elongate gonads aggregated in the ventral half on each side; 14 (left) –11 (right) in a 13 mm long individual, 2 (left)–8 (right) in a 12 mm long individual and 4 (left)–7 (right) in a 10 mm long individual. About 10 testicular follicles roughly arranged in a row on the side of attachment of each gonad.

Remarks: The present new species resembles closely *Cnemidocarpa areolata*, but the arrangement of gonads in the former is clearly of *Polycarpa*-type, the shape of the ciliated groove differs distinctly from that of the latter and the endocarps in the 1st intestinal loop are fewer than in the latter.

23. *Cnemidocarpa areolata* (Heller), 1878

(Pl. XXXV, Figs. 4–7)

A 7.5 mm long×5 mm wide individual (TK. No. 86) from Takarazima. The animal attached to the substratum by the left ventral side of the body which is roughly oval in outline. Branchial aperture terminal and faced slightly dorsads, the anterior margin of the atrial aperture at the middle of the body; both apertures 4-lobed. Test milky white, translucent and with a few faint irregular wrinkles on the surface. Thirty to forty longitudinal muscles arranged regularly on both sides except for the postero-ventral quater of the left side occupied by the alimentary canal. Two large endocarps on the right and about 10, including large and small ones, on the left side. Atrial tentacles ca. 20, delicate but fairly long.

Branchial sac: Tentacles ca. 20, large and small ones alternate regularly; besides ca. 10 minute ones. Ciliated groove a transverse groove slightly concave anteriorly. Inner longitudinal vessels arranged as follows:

Left	D.	0	(5)	2	(7)	2	(7)	2	(6)	1 V.
Right	D.	0	(5)	2	(6)	2	(7)	2	(6)	2 V.

Transverse and parastigmatic vessels alternate regularly. Four to six stigmata in a mesh.

Alimentary system: Stomach globular, with ca. 8 plications on each side; pyloric coecum indiscernible. One large and one small endocarps in the 1st intestinal loop. The axis of the second intestinal loop passes through the middle of the stomach. Anus faintly lobated. Gonad immature.

Remarks: This young specimen seems to belong to *Cn. areolata* rather than to the preceding species. Shallow second intestinal loop, the direction of its axis and the immaturity at the present body size seem to guarantee the present identification. Regular arrangement of longitudinal muscles is probably a feature found merely in very young stages.

24. *Styela partita* (Stimpson), 1852

(Pl. XXXVI, Figs. 1–7; Pl. XXXVII, Fig. 1)

Twenty eight specimens (TK. No. 87) from Takarazima, all smaller than 10 mm in length. The animal adheres to the substratum by the left ventral side of the body which is roughly elongate oval in outline. Branchial aperture subterminal and slightly faced dorsads, the atrial aperture near the middle of the body; both apertures sessile and 4-lobed.

Test: Leathery, of moderate thickness and reddish brown on the dorsal side, especially darkly coloured around the apertures, and fades towards the side of attachment, where the test is extremely thin and yellowish white. The surface is irregularly wrinkled in preserved specimens.

Mantle body: Mantle thin, yellowish white to pale orange in colour. Both siphons very short. Endocarps found on the inner surface on both sides, they are somewhat large but few in number. Fine atrial tentacles arranged thickly on the atrial velum.

Branchial sac: Twenty five to thirty three tentacles including large and small ones. Ciliated groove represented by a simple slit. Inner longitudinal vessels as follows:

10 mm long individual:

Left	D.	0	(6)	1	(5)	1	(10)	1	(6)	1	V.
Right	D.	1	(11)	1	(10)	0	(11)	1	(9)	1	V.

9 mm long individual:

Left	D.	1	(6)	1	(7)	0	(5)	1	(7)	0	V.
Right	D.	1	(9)	1	(7)	0	(7)	1	(6)	1	V.

Thicker transverse vessels and thinner ones alternate regularly, parastigmatic vessels occur regularly. Four to five remarkably long stigmata in a mesh, meshes along each side of the endostyle contain much more stigmata.

Alimentary system: The anterior margin of the intestinal loop reaches the middle or nearly 2/3 of the body. The second intestinal loop very large, the axis passes through the oesophagus. Stomach elongate, much longer than a half of the ventral branch of the 1st intestinal loop, with ca. 8 plications on each side and a distinct and large pyloric coecum. Two-four endocarps in the 1st intestinal loop. Anus plainly margined or with a few indistinct lobes.

Gonad: Two on each side, rarely some of them are missing. Testicular follicles situated at the posterior end of each elongate ovary, 2–4 in number and complexly lobed in some specimens.

Larva: In a specimen, two larvae were found in the peribranchial cavity. They are 1 mm in length; trunk about 200 μ in length, width/length 0.6. Three attachment processes minute. Sensory pigment fleck/trunk width 0.18.

Remarks: The present specimens differ from the typical form of *St. partita* in the following 3 points, besides several slight differences: (1) endocarps few but large, (2) a few testicular follicles confined to the posterior end of the ovary and (3) stomach large, elongate and with fewer plications. These differences are, however, attributable to the environmental condition which allowed the animals to attain the maturity at such small body size.

25. *Microcosmus curvus* n. sp.

(Pl. XXXVII, Figs. 2–9)

Numerous specimens from both Takarazima (Type 142) and Nakanosima (TK. No. 88), the largest one of all is 12 mm in length. The animal roughly oval in shape and attached to the substratum by the right ventral side of the body. The branchial aperture terminal or subterminal, the atrial at the middle of the body or slightly posterior to it, both apertures 4-lobed. Siphons short; a specimen from Nakanosima has a long branchial siphon as shown in Pl. XXXVII, fig. 3. Usually dark violet when alive, but fades to purplish brown in preservation. Some specimens from Nakanosima are reddish brown in colour and I dealt them, at a sight, erroneously with *St. partita*.

Test: Leathery, very tough and moderately thick on the dorsal side but very thin and coloured yellowish brown at the side of attachment. The surface is irregularly wrinkled and provided with many shallow grooves.

Mantle body: Mantle pale yellowish orange as a whole, siphons pale orange. Muscles arranged very regularly as in other species of the genus. Endocarps absent.

Spinules on the distal part of the stomodaeum 17–22 μ in length. Atrial velum indistinct.

Branchial sac: Usually six folds on each side.

12 mm long individual:

Left D. 1 (15) 1 (15) 1 (14) 1 (13) 1–2 (12) 2 (8) 1 V.

Right D. 1 (15) 1 (12) 1 (14) 1 (15) 2 (13) 1–2 (10) 0 (6) 0 (4) 0 V.

10 mm long individual:

Left D. 1 (12) 1 (9) 1 (11) 1 (11) 1 (10) 1 (6) 1 V.

Right D. 0 (11) 1 (8) 1 (12) 1 (11) 1 (12) 1 (8) 1 V.

Folds VII and VIII on the right side in a 12 mm long individual are confined to the anterior portion of the sac. A 5 mm long individual from Nakanosima has only 5 folds on the left side. One or two thinner transverse vessels between each pair of thicker ones, parastigmatic vessels present. Three to six stigmata in a mesh. Tentacles short and thick, 17–21 including large and small ones; branches in 2 orders, those of the second order are few. Ciliated groove U-shaped, with one or both arms curled in.

Alimentary system: Liver forms a mass and pale greenish in colour. Anus with two plain lips.

Gonad: A strongly curved genital capsule on each side. Oviduct always opens towards the branchial siphon. The capsule on the left side lies across the dorsal branch of the 1st intestinal loop.

Remarks: The constantly curved gonad is the most remarkable characteristic of the present new species.

EXPLANATION OF PLATE XVIII

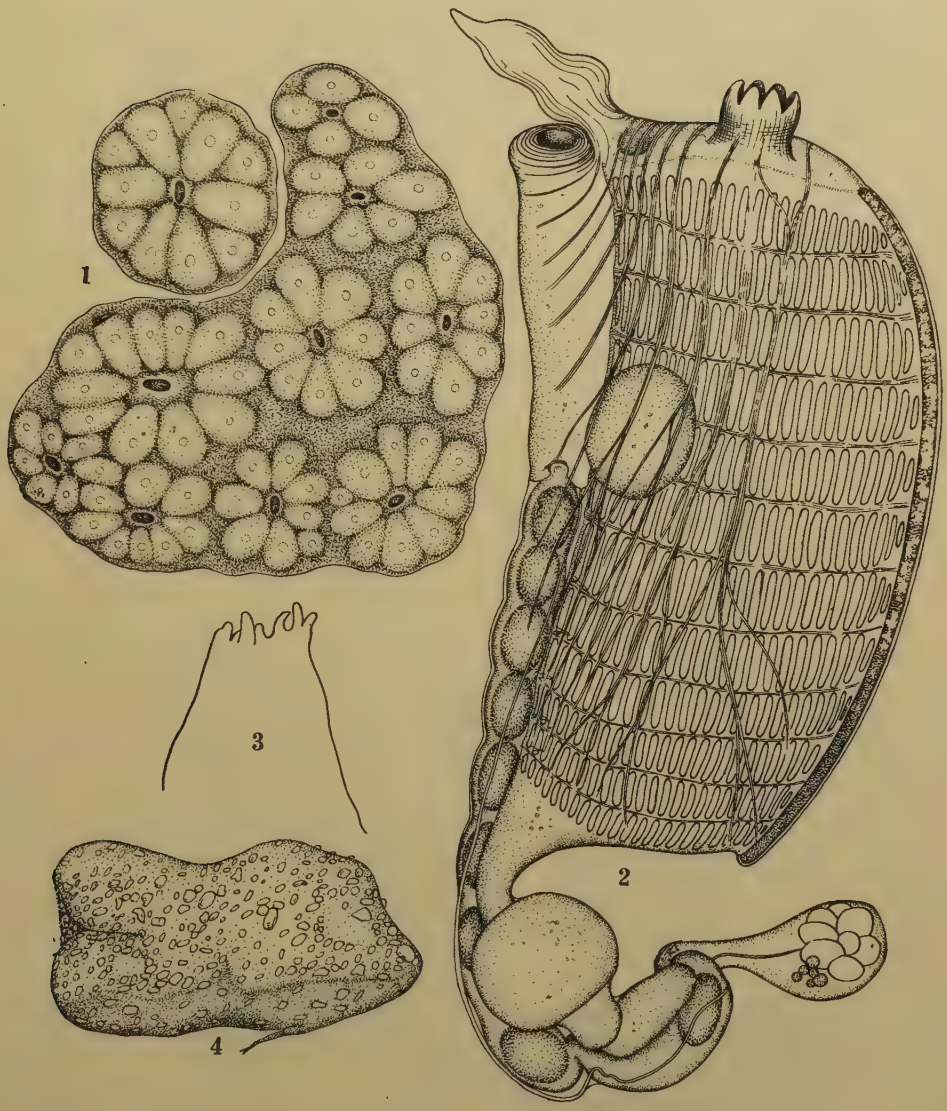
Figs. 1–3. *Polyclinum tsutsuii* n. sp.

1—Two colonies, enlarged.

2—Zooid from right side, magnified.

3—Tip of atrial languet. ×80.

Fig. 4. *Aplidiopsis tokaraensis* n. sp. A colony, enlarged.



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EXPLANATION OF PLATE XIX

Figs. 1–3. *Aplidiopsis tokaraensis* n. sp.

1—Zooid from right side. ×33.

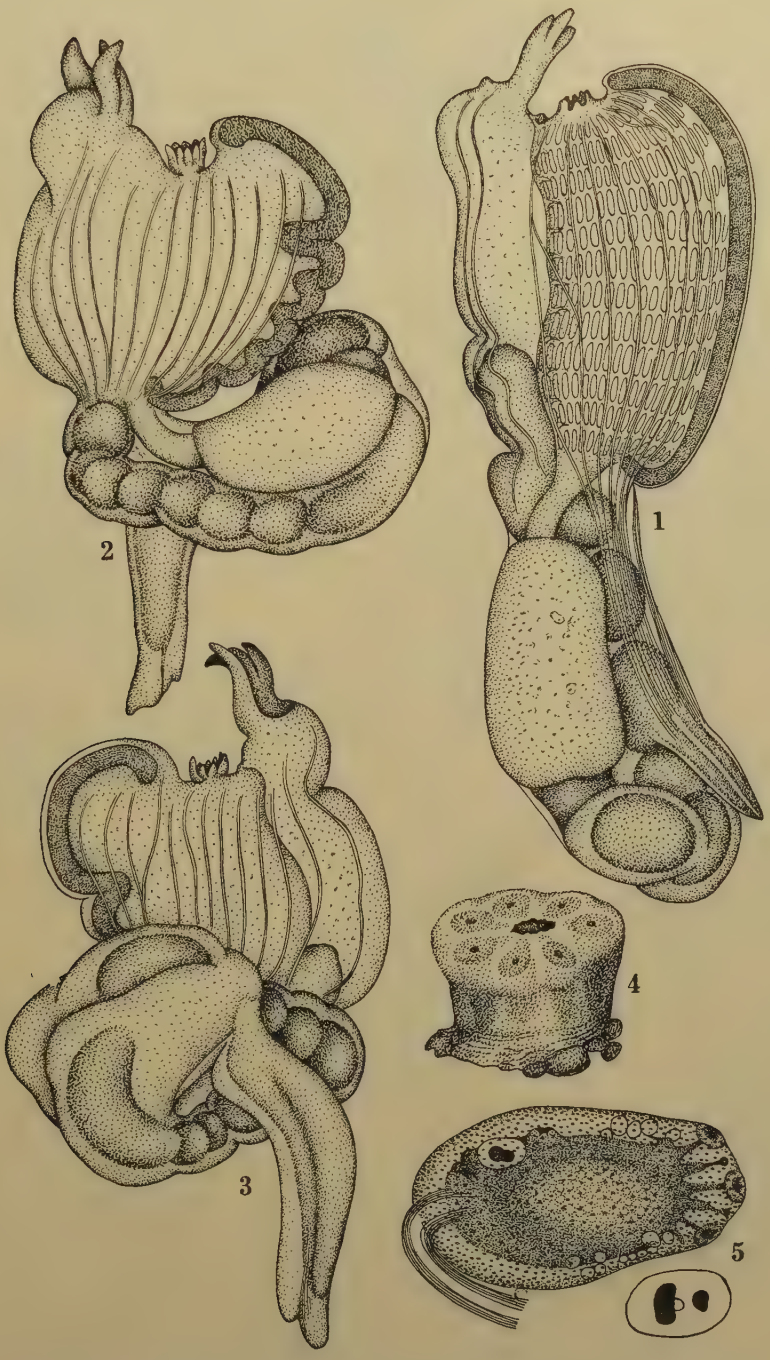
2—Contracted zooid from right side. ×33.

3—Contracted zooid from left side. ×33.

Figs. 4–5. *Amaroucium monotonicum* n. sp.

4—A colony, enlarged.

5—Larva from right side, ×110; with statocyst, magnified.



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EXPLANATION OF PLATE XX

Fig. 1. *Amaroucium monotonicum* n. sp. Zooid from right side. ×75.

Figs. 2–7. *Didemnum* (*Didemnum*) *moseleyi* (HERDMAN)

2—Schema of the section of colony.

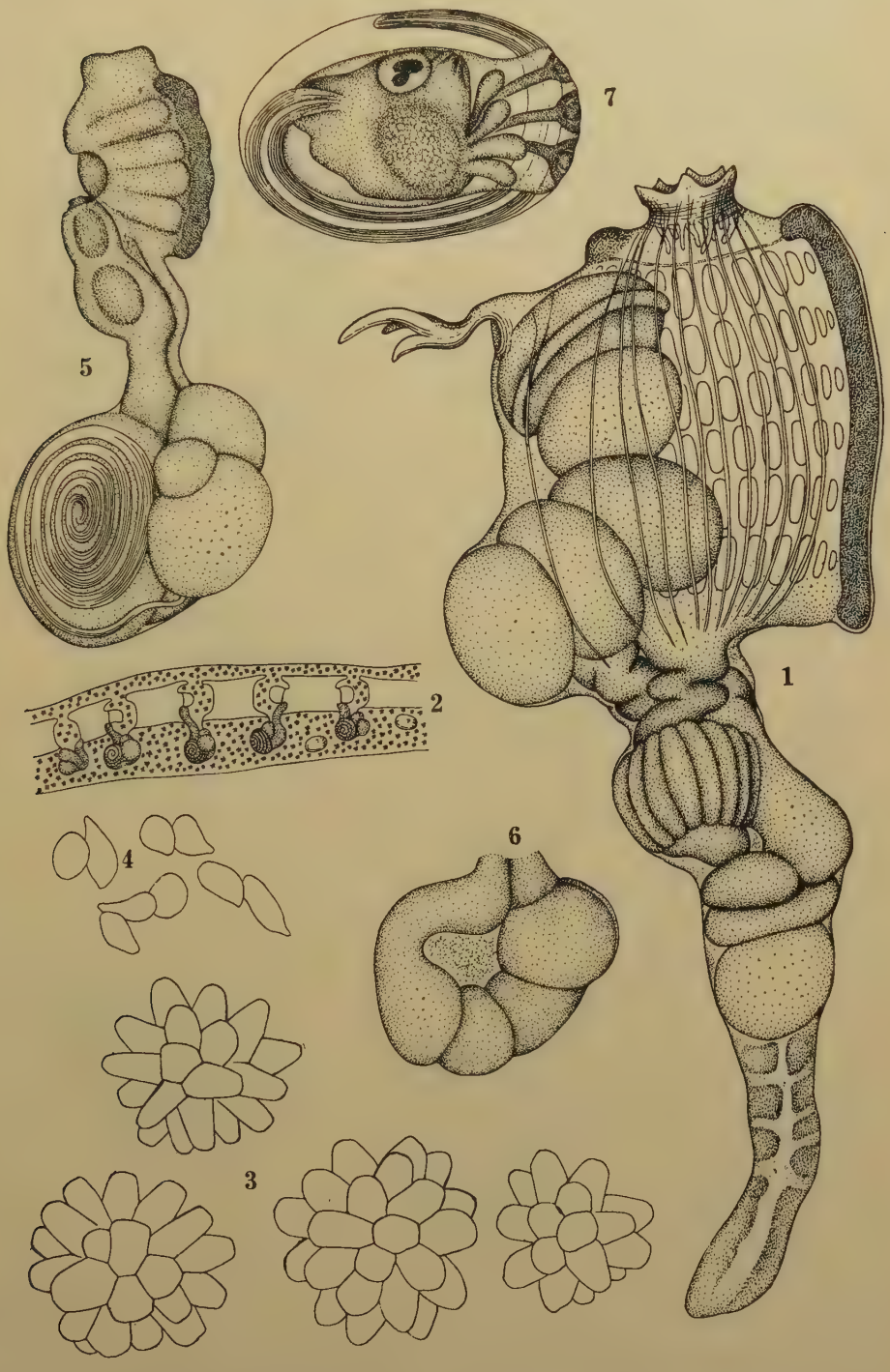
3—Calcareous spicules. ×630.

4—Bladder cells in test. ×630.

5—Zooid from right side. ×75.

6—Abdomen. ×75.

7—Embryo from right side. ×110.



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EXPLANATION OF PLATE XXI

Figs. 1–4. *Didemnum* (*Didemnum*) *moseleyi* f. *granulatum* nov.

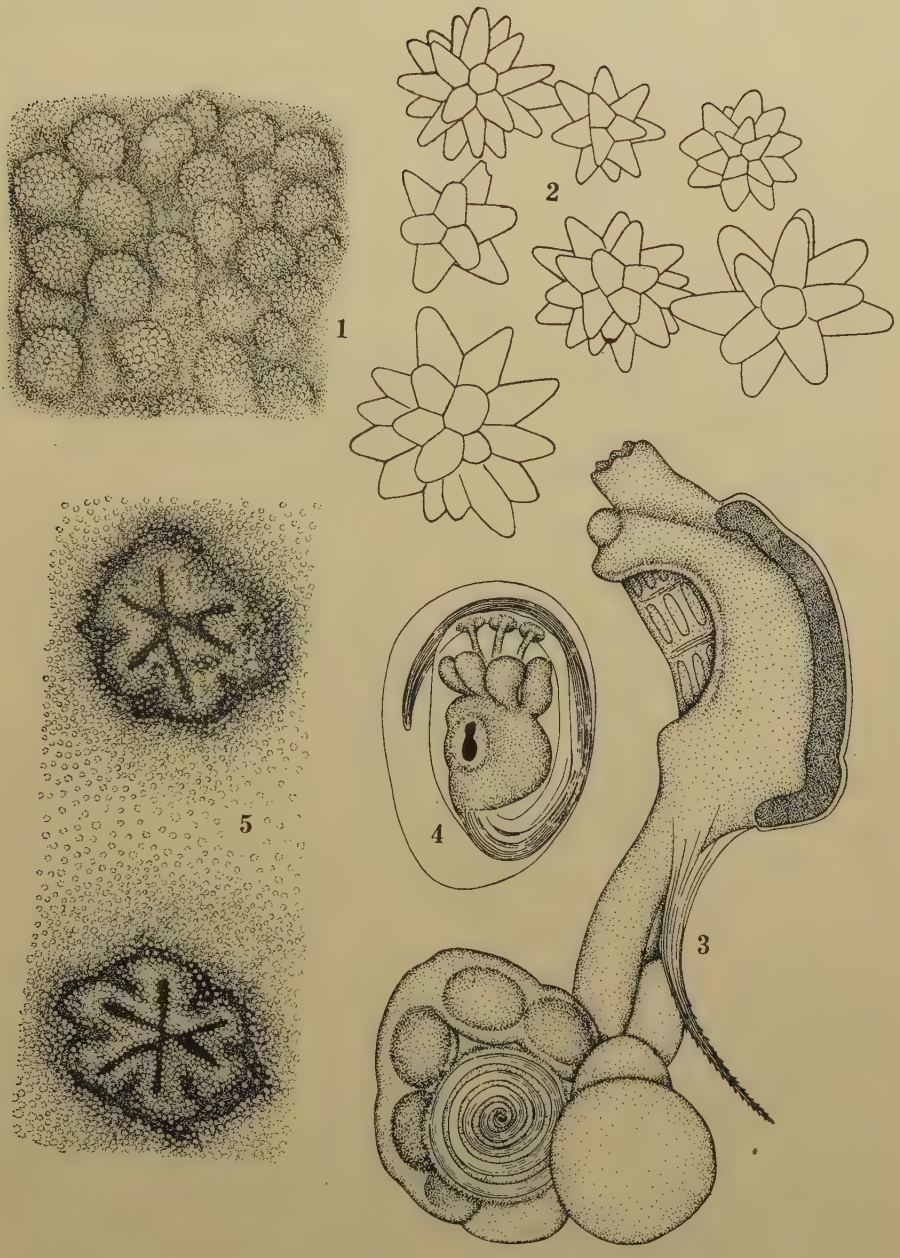
1—A part of the surface of colony. ×75.

2—Calcareous spicules. ×630.

3—Zooid from the right side. ×110.

4—Embryo from right side. ×110.

Fig. 5. *Didemnum* (*Didemnum*) *moseleyi* f. *punici-color* nov.
A part of the surface of colony, showing two branchial apertures. ×75.



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EXPLANATION OF PLATE XXII

Figs. 1–3. *Didemnum* (*Didemnum*) *moseleyi* f. *punici-color* nov.

1—Calcareous spicules. ×630.

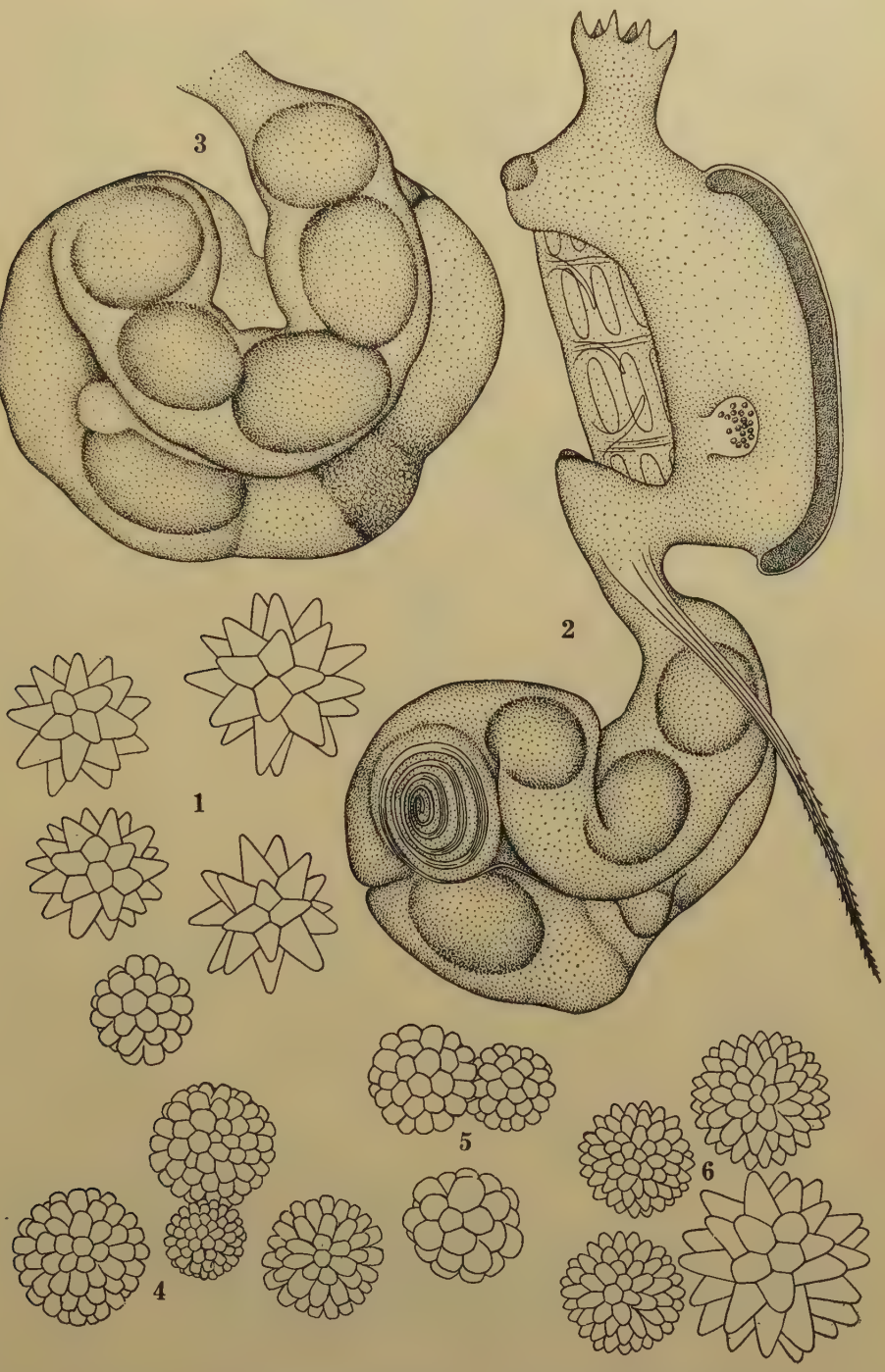
2—Zooid from right side. ×110.

3—Abdomen with immature gonad. ×110.

Figs. 4–6. *Didemnum* (*Didemnum*) *candidum* SAVIGNY

4, 5—Calcareous spicules from different colonies spiculate densely. ×630.

6—Spicules from the colony spiculate rather sparsely. ×630.



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EXPLANATION OF PLATE XXIII

Figs. 1–7. *Didemnum* (*Didemnum*) *candidum* SAVIGNY

1—Zooid from right side (contracted). ×110.

2—Normal larva from right side. ×110.

3—Larva with 2 attachment processes. ×110.

4—Larva with a single attachment process. ×110.

5—Granulated spindle cells in test. ×630.

6—Zooid from right side (expanded). ×75.

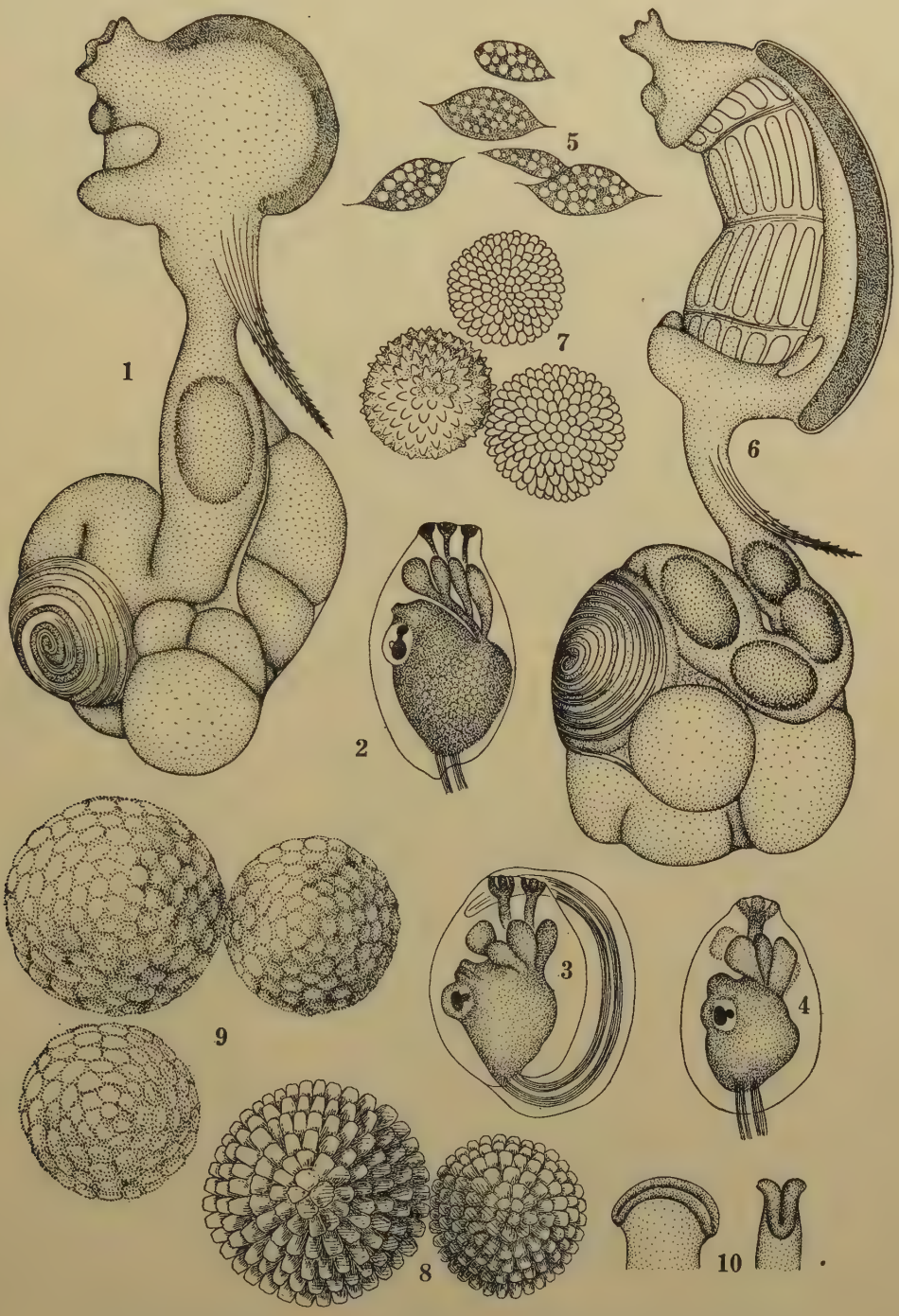
7—Calcareous spicules from a pinkish colony. ×630.

Figs. 8–10. *Didemnum* (*Didemnum*) *pulvinum* nom. nov.

8—Calcareous spicules from a greenish colony. ×630.

9—Calcareous spicules from a yellowish-brown colony. ×630.

10—Anus of zooid, magnified.



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EXPLANATION OF PLATE XXIV

Figs. 1–5. *Didemnum* (*Didemnum*) *pulvinum* nom. nov.

1—Schema of the optical section of the colony, enlarged.

2—Zoochlorellae from greenish colonies. ×1200.

3—Zoochlorellae from yellowish-brown colonies. ×1200.

4—Zooid from right side. ×75.

5—Abdomen from left side. ×75.

Figs. 6–7. *Lissoclinum fragile* (Van Name),

6—Calcareous spicules. ×630.

7—Zooid from right side, magnified.

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EXPLANATION OF PLATE XXV

Figs. 1–2. *Lissoclinum fragile* (VAN NAME)

1—Abdomen from upper side. ×75.

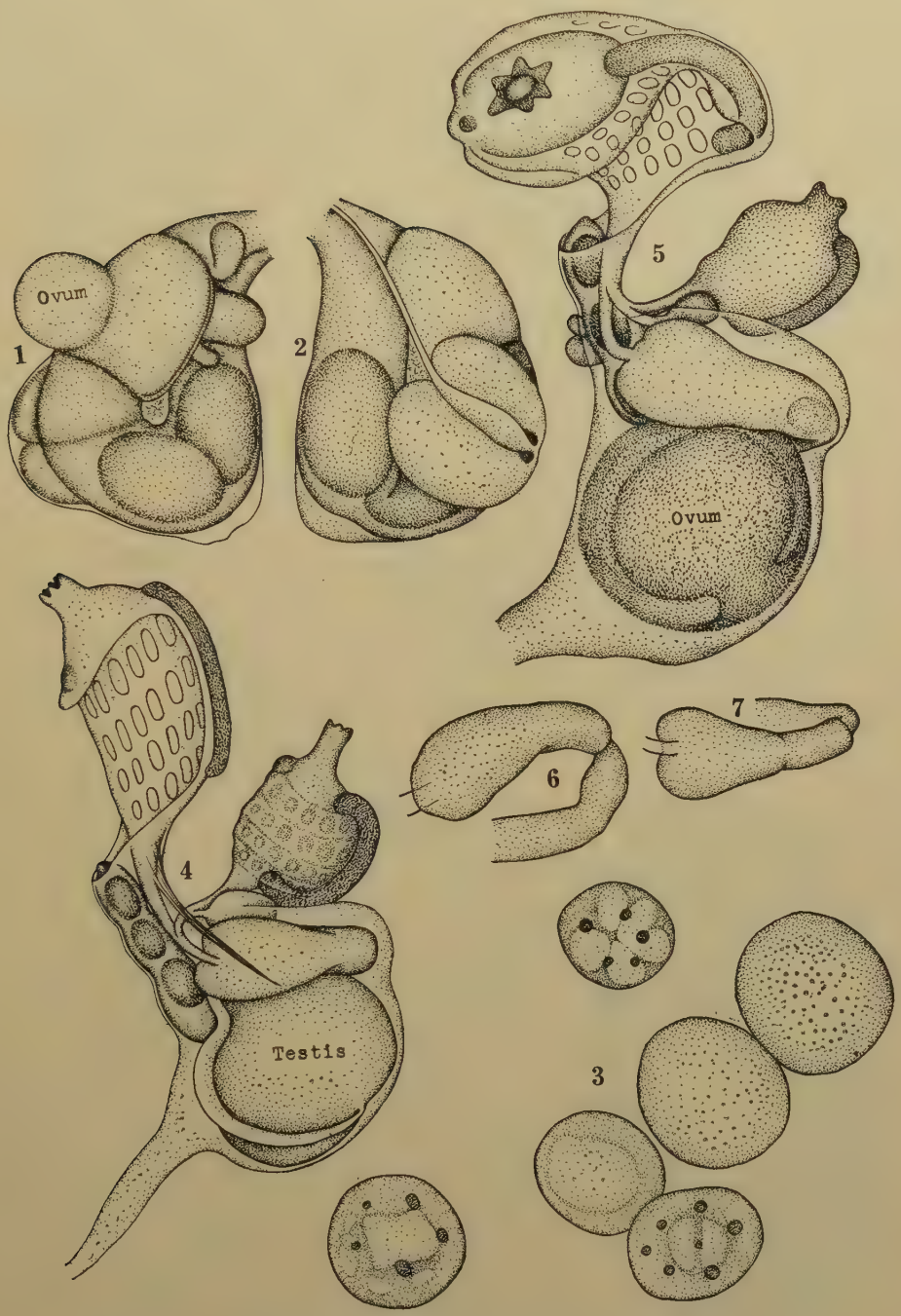
2—Abdomen from under side. ×75.

Figs. 3–7. *Leptoclinum midori* n. sp.

3—Zoochlorellae. ×1200.

4, 5—Zooids from right side. ×75.

6, 7—Alimentary canals. ×75.



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EXPLANATION OF PLATE XXVI

Figs. 1–3. *Podoclavella polycitorella* n. sp.

1—An individual from right side, enlarged.

2—Mantle body from right side, magnified.

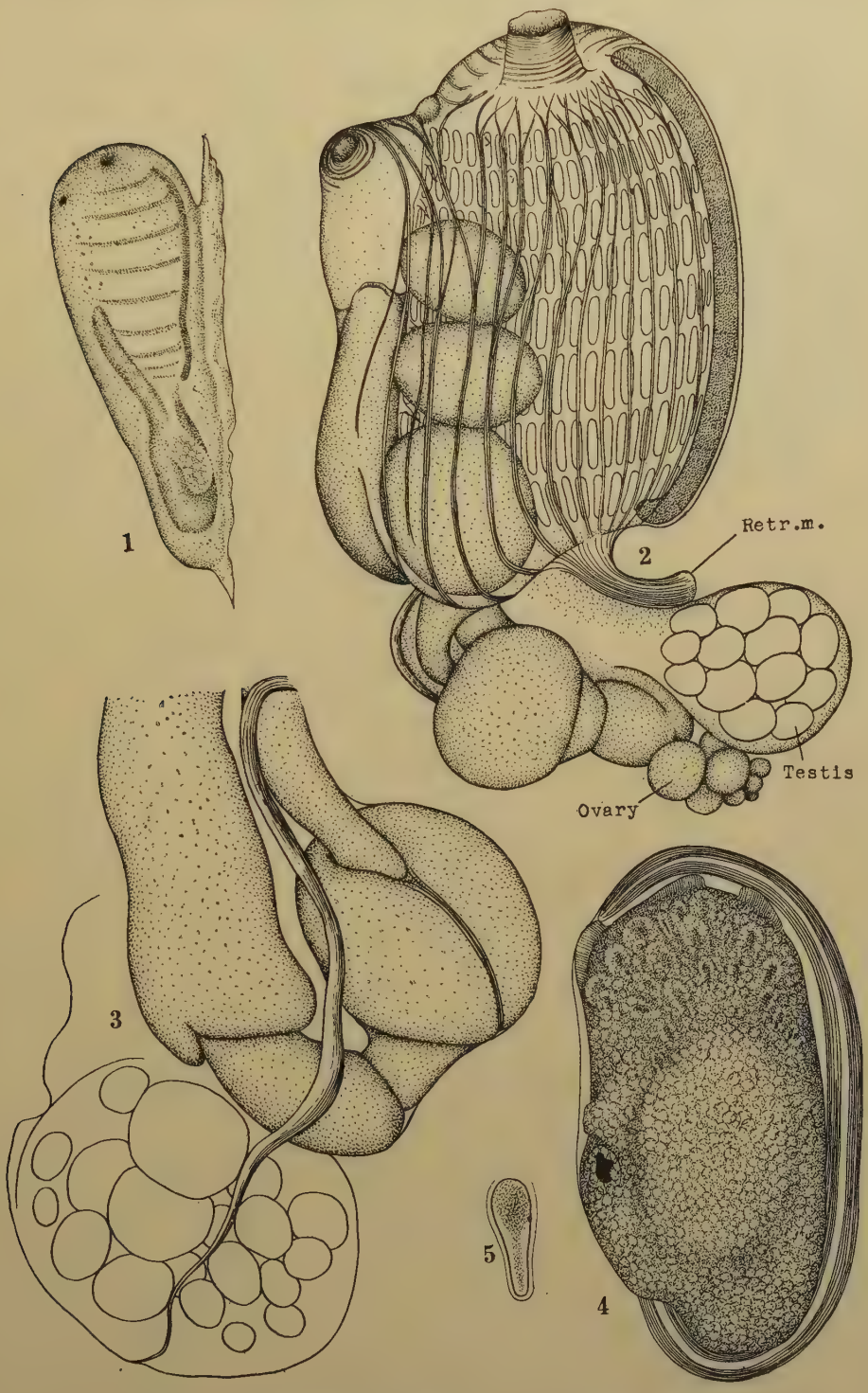
Retr. m.—retractile muscle.

3—Genital sac and posterior part of abdomen. ×75.

Figs. 4–5. *Eudistoma snakabri* n. sp.

4—Embryo from right side. ×55.

5—Distal end of an attachment process, magnified.



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EXPLANATION OF PLATE XXVII

Figs. 1–5. *Eudistoma snakabri* n. sp. ×25.

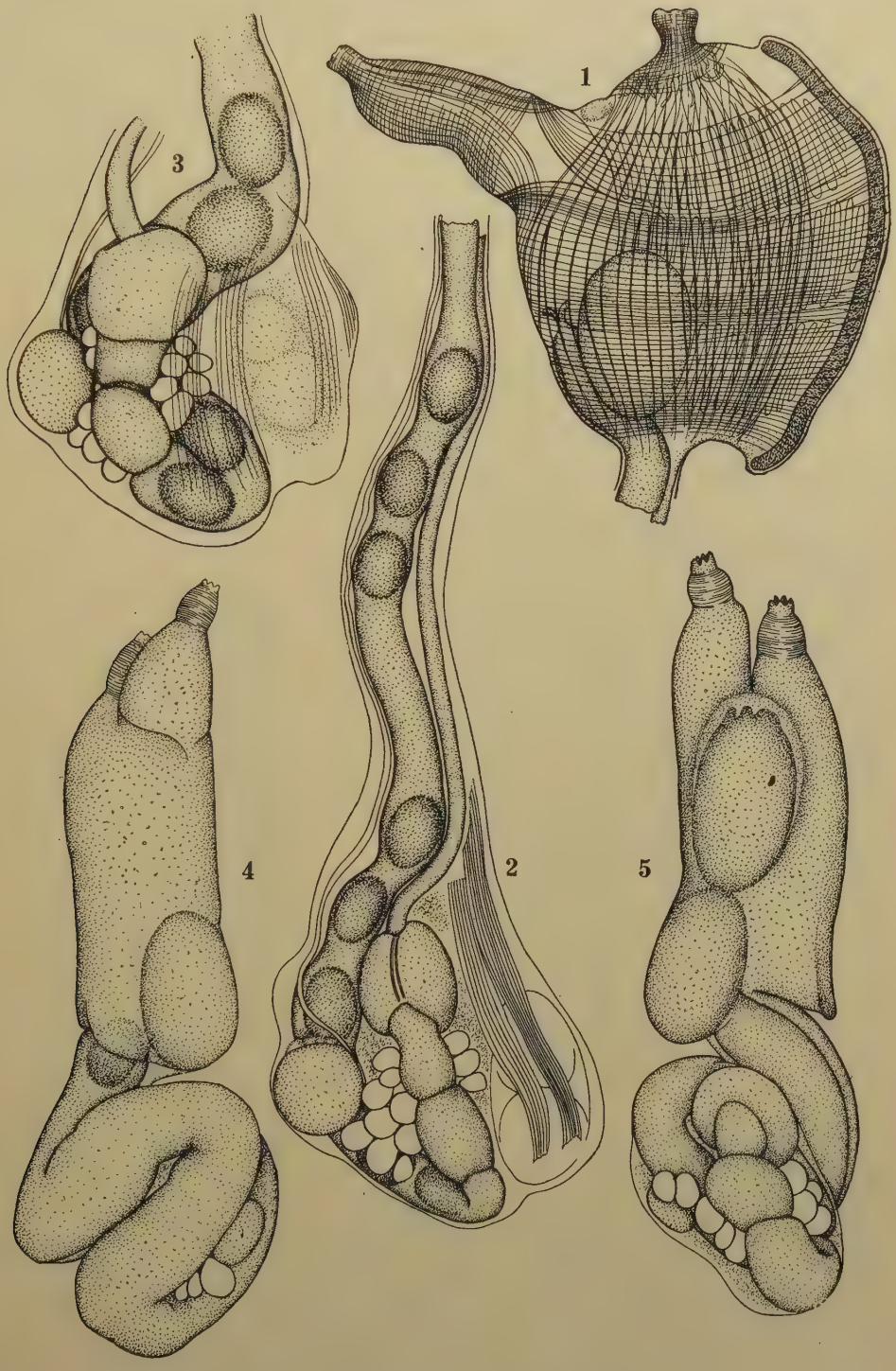
1—Thorax from right side.

2—Abdomen.

3—Posterior part of abdomen.

4—Contracted zooid from left side.

5—Contracted zooid from right side.



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EXPLANATION OF PLATE XXVIII

Fig. 1. *Eudistoma snakabri* n. sp. Thorax with long atrial siphon. ×25.

Figs. 2–6. *Eudistoma rubra* n. sp.

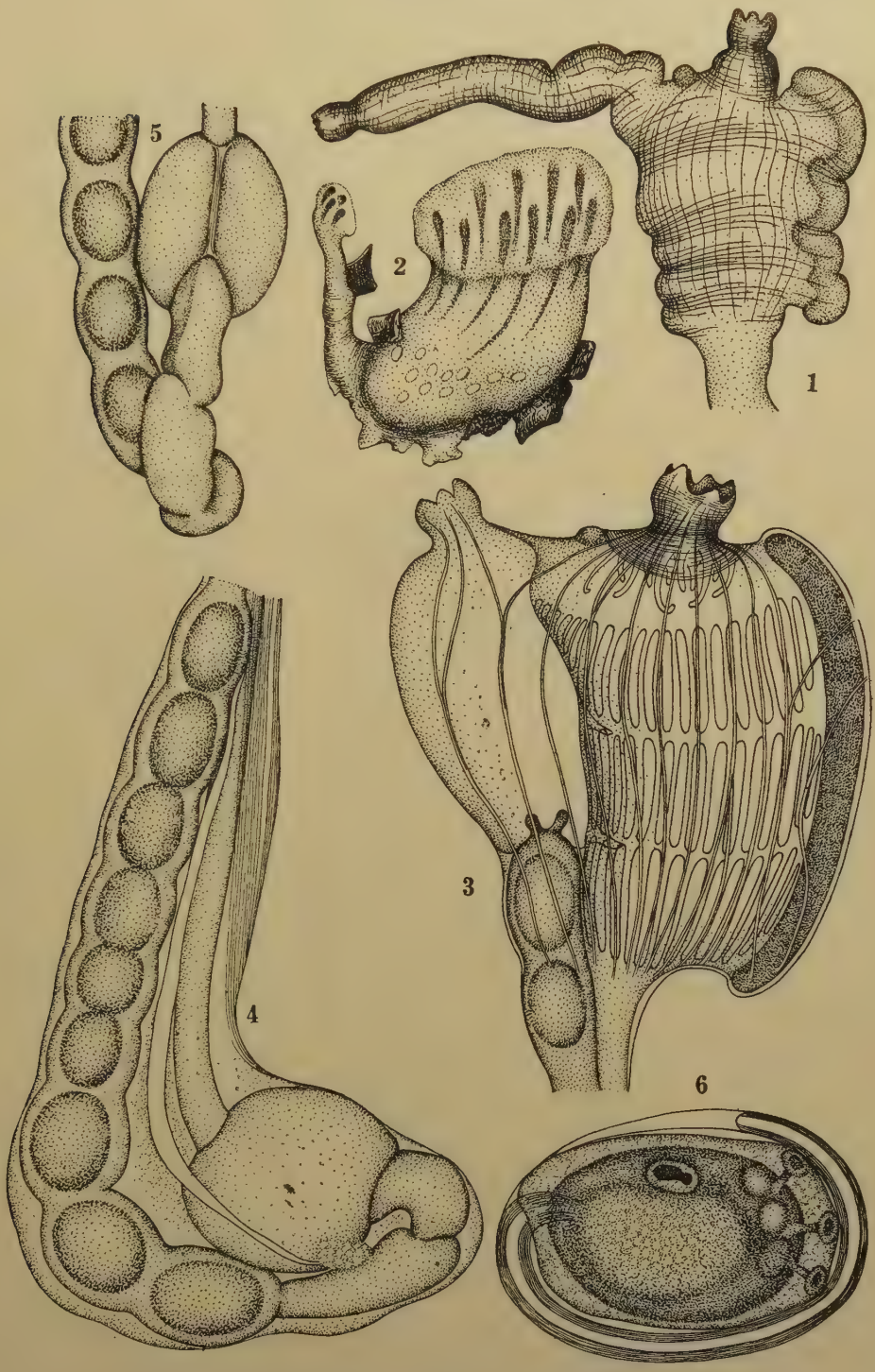
2—Colony, enlarged.

3—Thorax from right side. ×45.

4—Abdomen. ×45.

5—Posterior part of alimentary canal. ×45.

6—Embryo from right side. ×75.



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EXPLANATION OF PLATE XXIX

Figs. 1–2. *Eudistoma tokarae* n. sp.

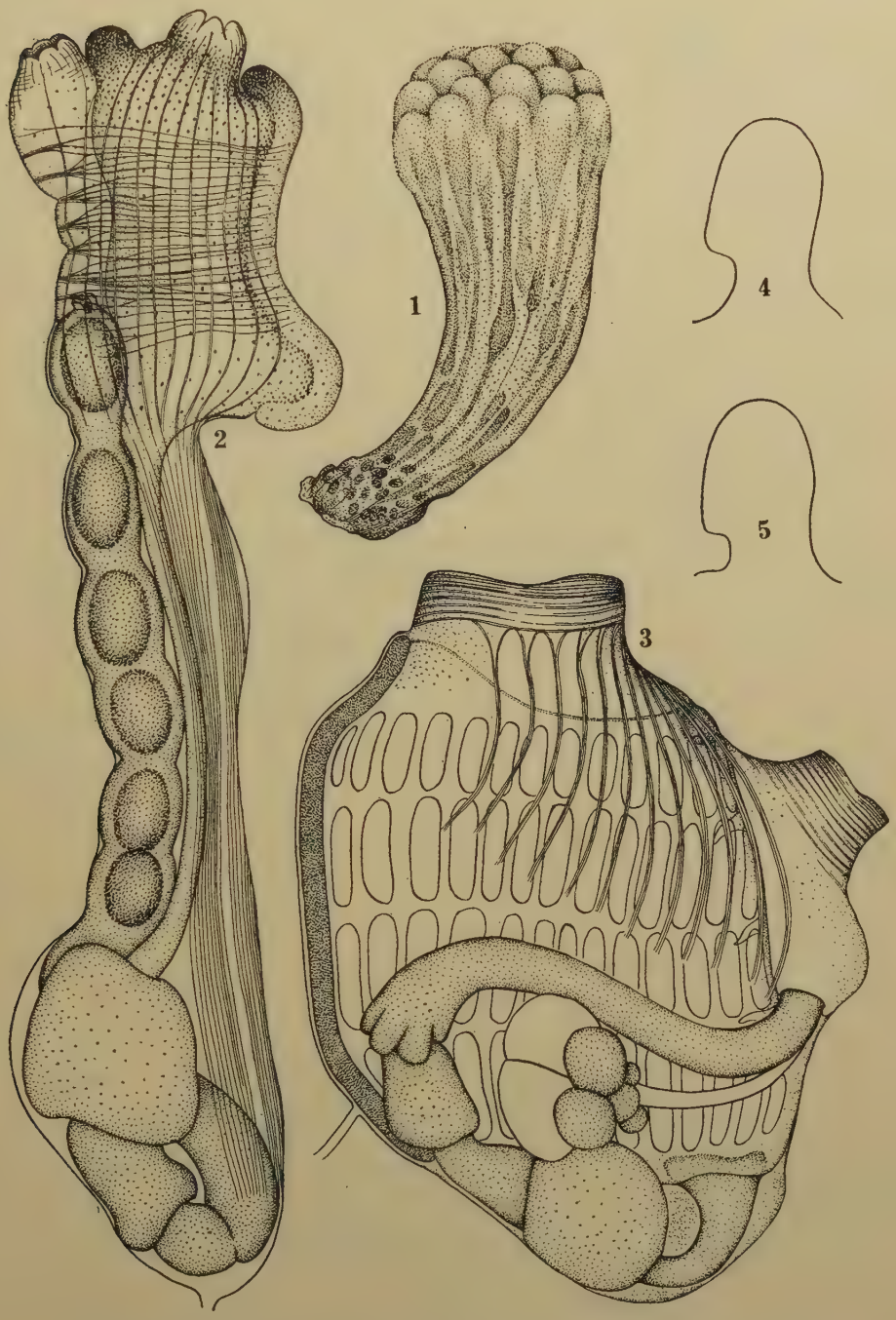
1—6 mm long colony.

2—Zooid from right side. ×75.

Figs. 3–5. *Perophora listeri* var. *tokarae* nov.

3—Mantle body from left side, magnified.

4, 5 —Two of papillae supporting the inner longitudinal vessel. ×200.



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EXPLANATION OF PLATE XXX

Figs. 1–5. *Ecteinascidia tokaraensis* n. sp.

1—An individual from left side, enlarged.

2—Optical section of stomach, enlarged.

3—Ciliated groove and the anterior end of dorsal lamina. ×75.

4—A part of dorsal lamina. ×75.

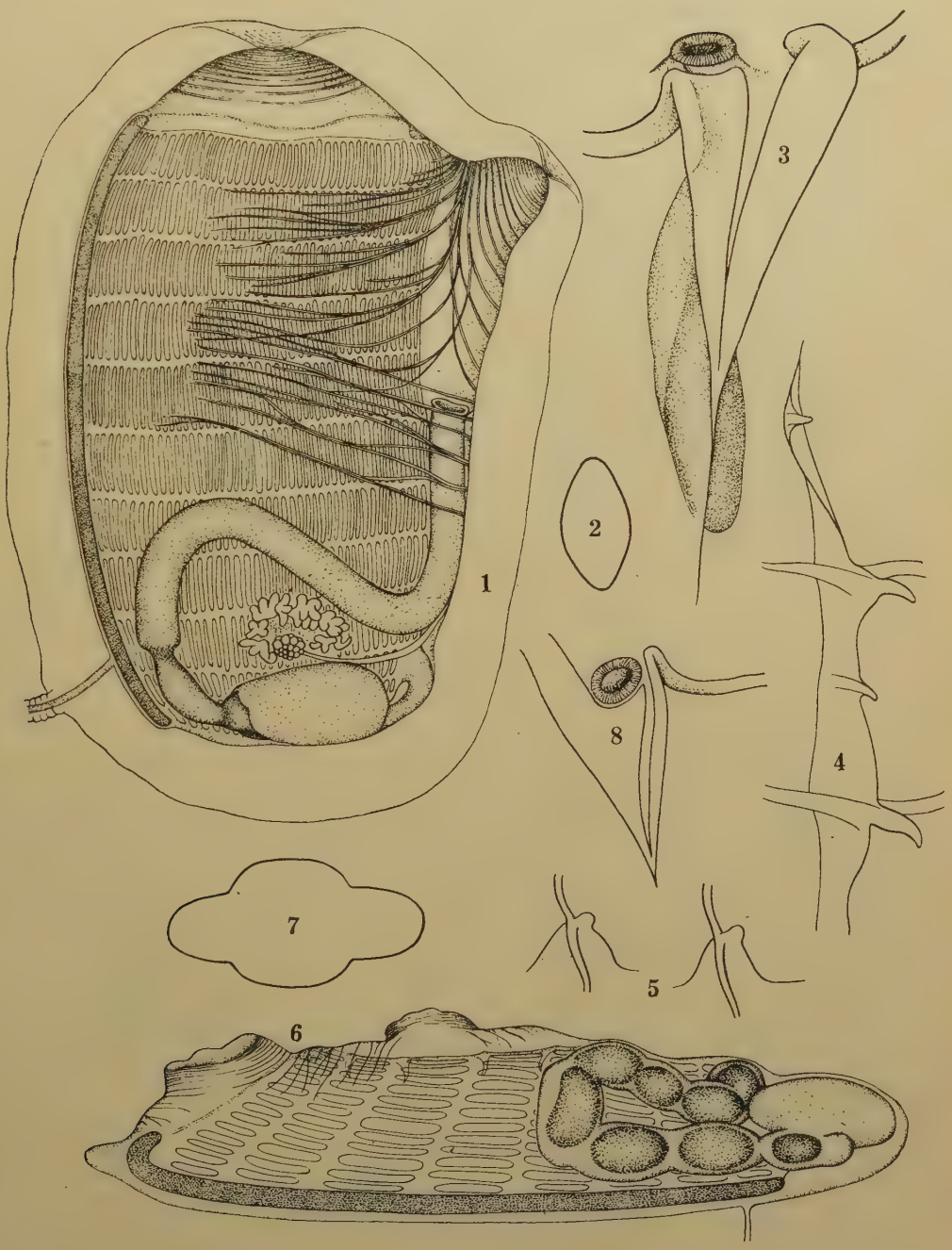
5—Two of papillae supporting the inner longitudinal vessel. ×75.

Figs. 6–8. *Ecteinascidia jacerens* n. sp.

6—An individual from left side, enlarged.

7—Optical section of stomach, magnified.

8—Ciliated groove and the anterior end of dorsal lamina, magnified.



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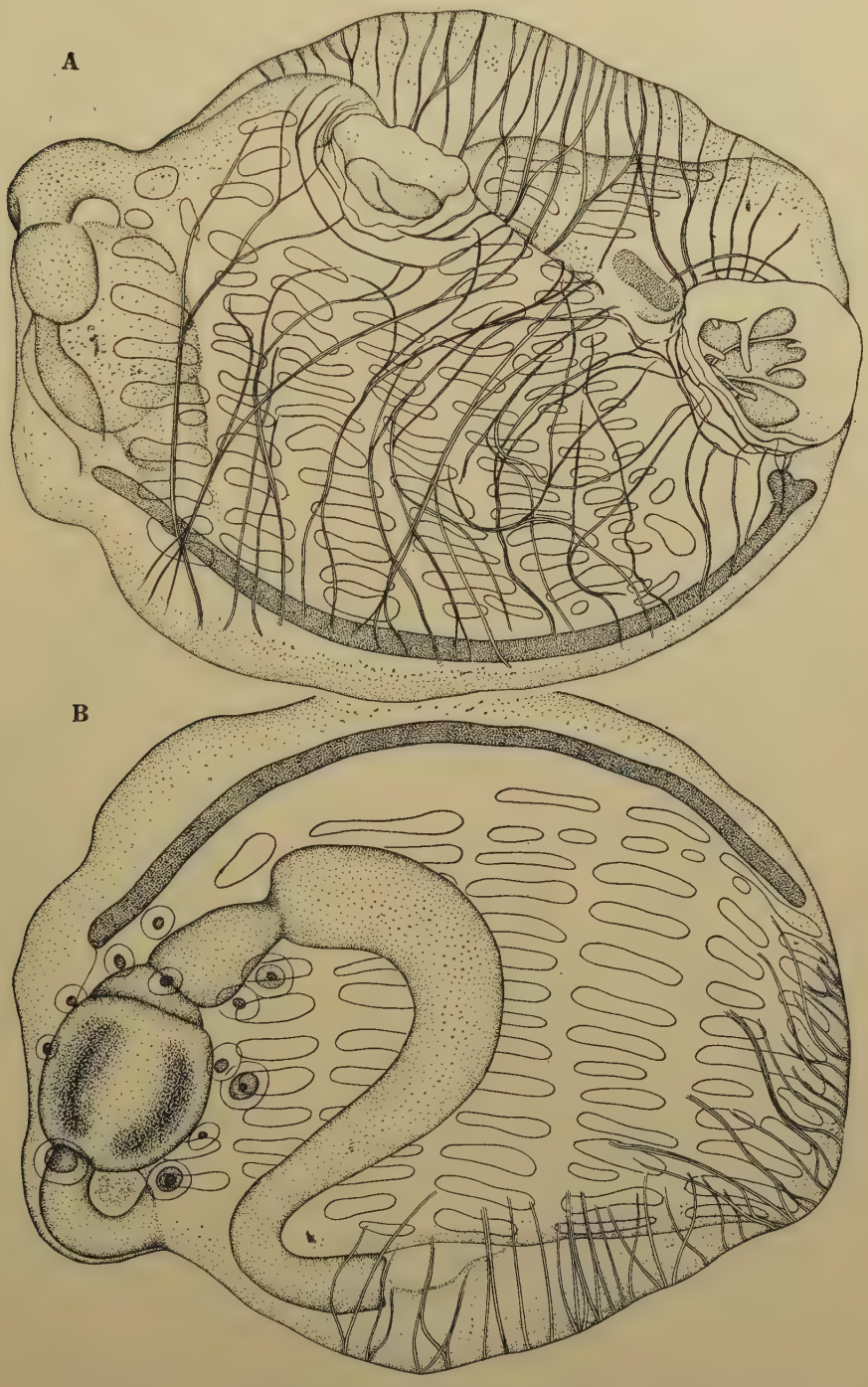
EXPLANATION OF PLATE XXXI

Figs. A–B. *Ecteinascidia jacerens* n. sp. ×ca. 60.

A—Right dorsal side.

B—Left ventral side.



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EXPLANATION OF PLATE XXXII

Fig. 1. *Ecteinascidia jacerens* n. sp. 1—Elongate stomach. ×75.

Figs. 2–8. *Ascidia aperta* SLUITER

2—53 mm long and faintly coloured individual.

3—40 mm long and well coloured individual.

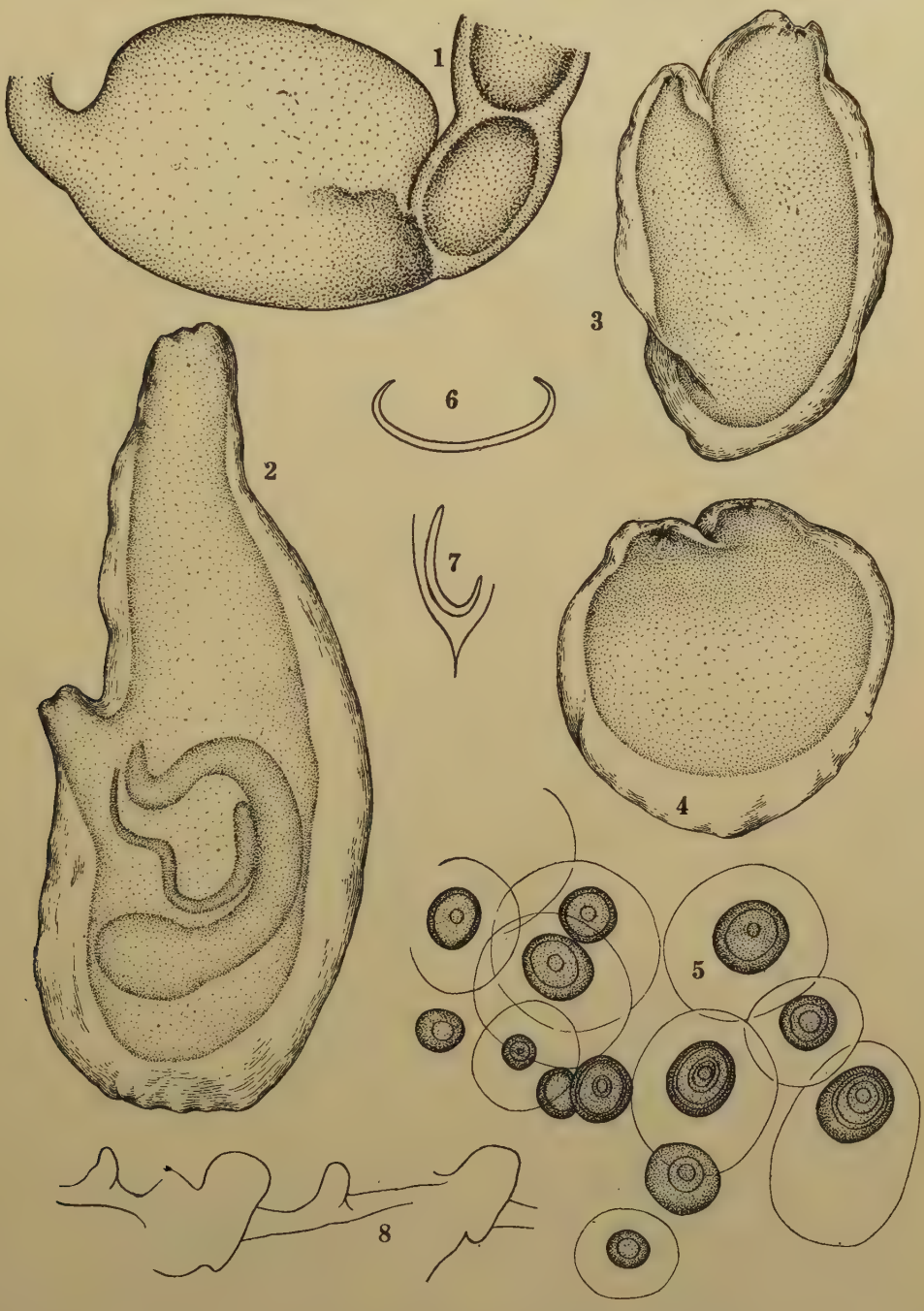
4—28 mm long and deeply coloured individual.

5—Concentric yellowish-brown bodies along the alimentary canal. ×75.

6—Ciliated groove of the 53 mm long individual, magnified.

7—Ciliated groove of the 28 mm long individual, magnified.

8—Supporting papillae of the inner longitudinal vessel. ×75.



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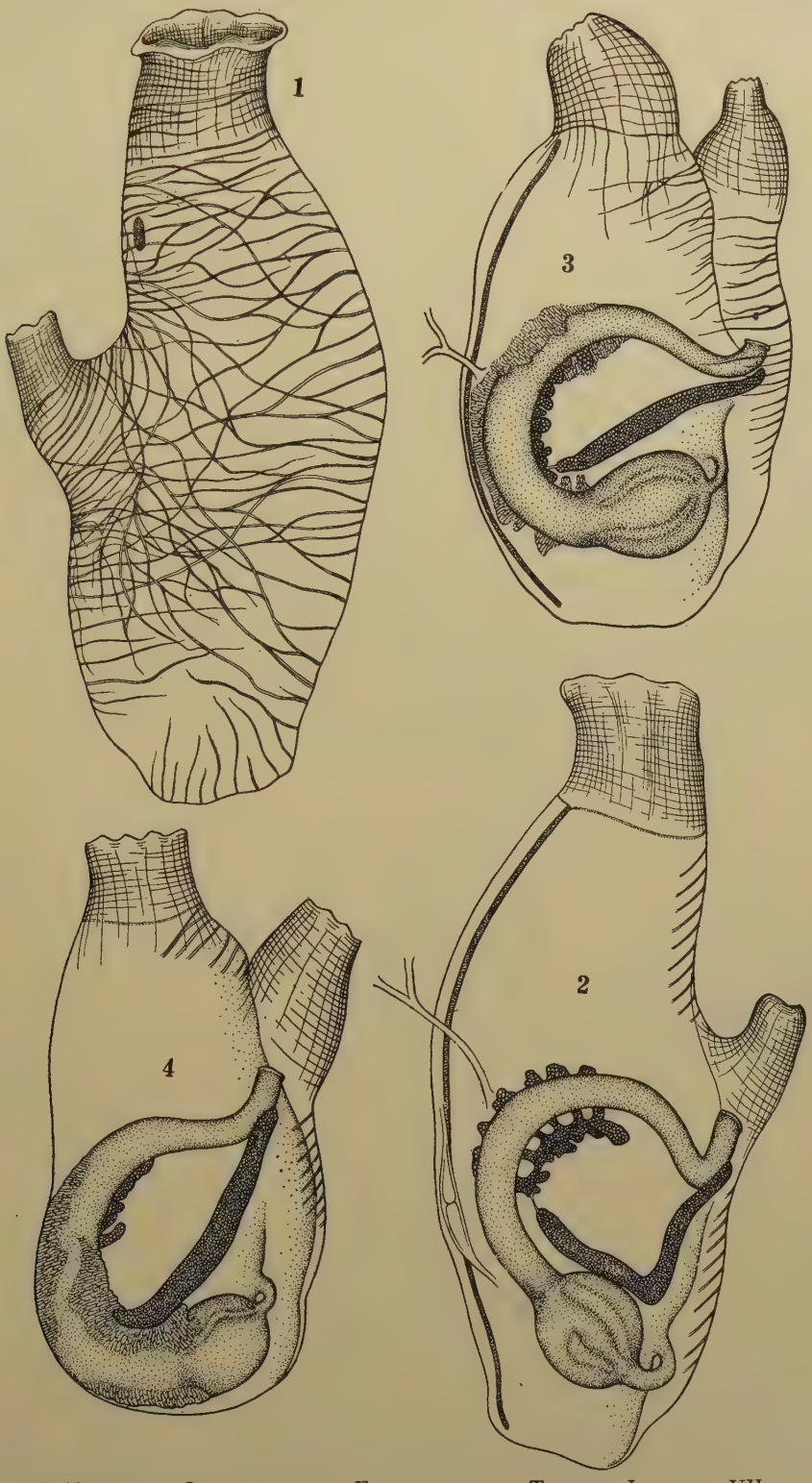
EXPLANATION OF PLATE XXXIII

Figs. 1–4. *Ascidia aperta* SLUITER

1—Mantle body of the 53 mm long individual, right side.

2—Mantle body of the 53 mm long individual, left side.

3, 4—Mantle bodies of two 40 mm long individuals, left side.



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EXPLANATION OF PLATE XXXIV

Figs. 1–5. *Ascidia beta* n. sp.

1—Entire animal from right side, enlarged.

2—Mantle body from right side, enlarged.

3—Mantle body from left side, enlarged.

4—Ciliated groove, magnified.

5—Supporting papillae of the inner longitudinal vessel. ×200.

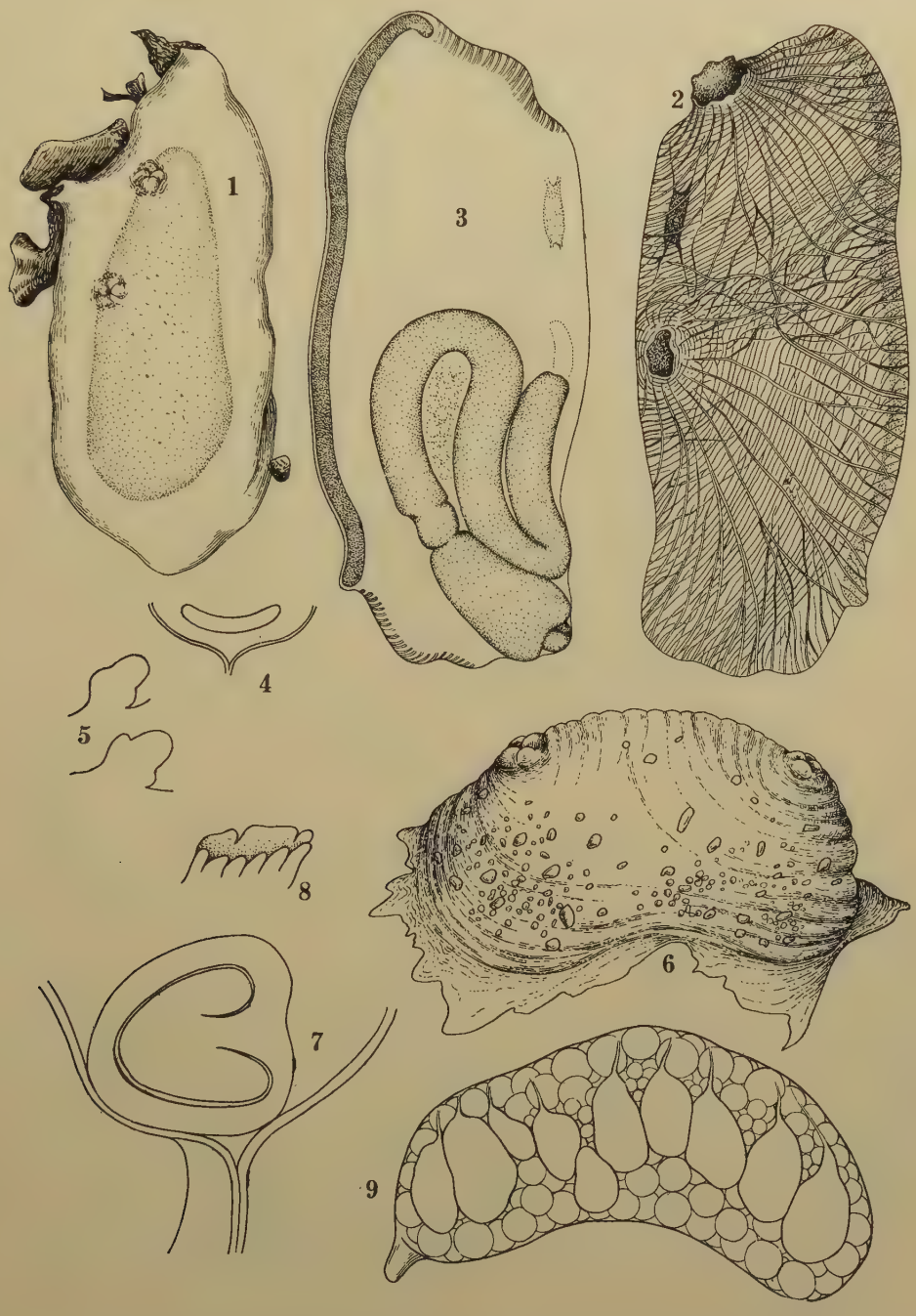
Figs. 6–9. *Polycarpa takarazima* n. sp.

6—13 mm long individual.

7—Ciliated groove, magnified.

8—Anus, magnified.

9—A gonad, side of attachment. ×50.



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EXPLANATION OF PLATE XXXV

Figs. 1–3. *Polycarpa takarazima* n. sp.

1—Right half of mantle body of 13 mm long individual, inside.

2—Left half of mantle body of 13 mm long individual, inside.

3—Left half of mantle body of 12 mm long individual, inside.

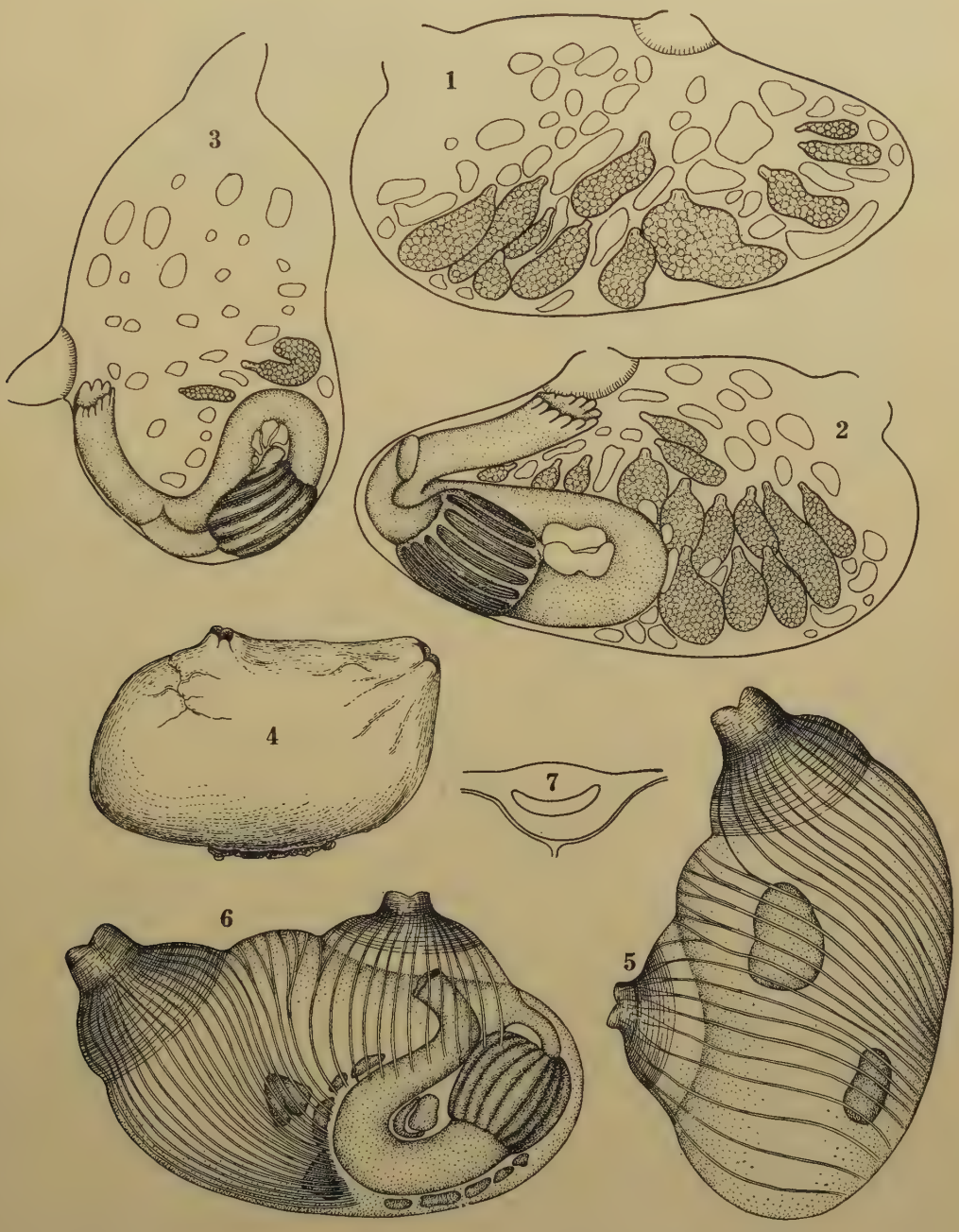
Figs. 4–7. *Cnemidocarpa areolata* (HELLER)

4—7.5 mm long individual.

5—Mantle body from right side.

6—Mantle body from left side.

7—Ciliated groove, magnified.



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EXPLANATION OF PLATE XXXVI

Figs. 1–7. *Styela partita* (STIMPSON)

1—10 mm long individual.

2—Left half of mantle body of 10 mm long individual, inside.

3—Right half of mantle body of 10 mm long individual, inside.

4—Right half of mantle body of 9 mm long individual, inside.

5—Left half of mantle body of 9 mm long individual, inside.

6—Ciliated groove of 10 mm long individual, magnified.

7—Ciliated groove of 9 mm long individual, magnified.

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EXPLANATION OF PLATE XXXVII

Fig. 1. *Styela partita* (STIMPSON) 1—Larva. ×200.

Figs. 2–9. *Microcosmus curvus* n. sp.

2—10 mm long individual from Takarazima, left side.

3—10 mm long individual from Nakanosima.

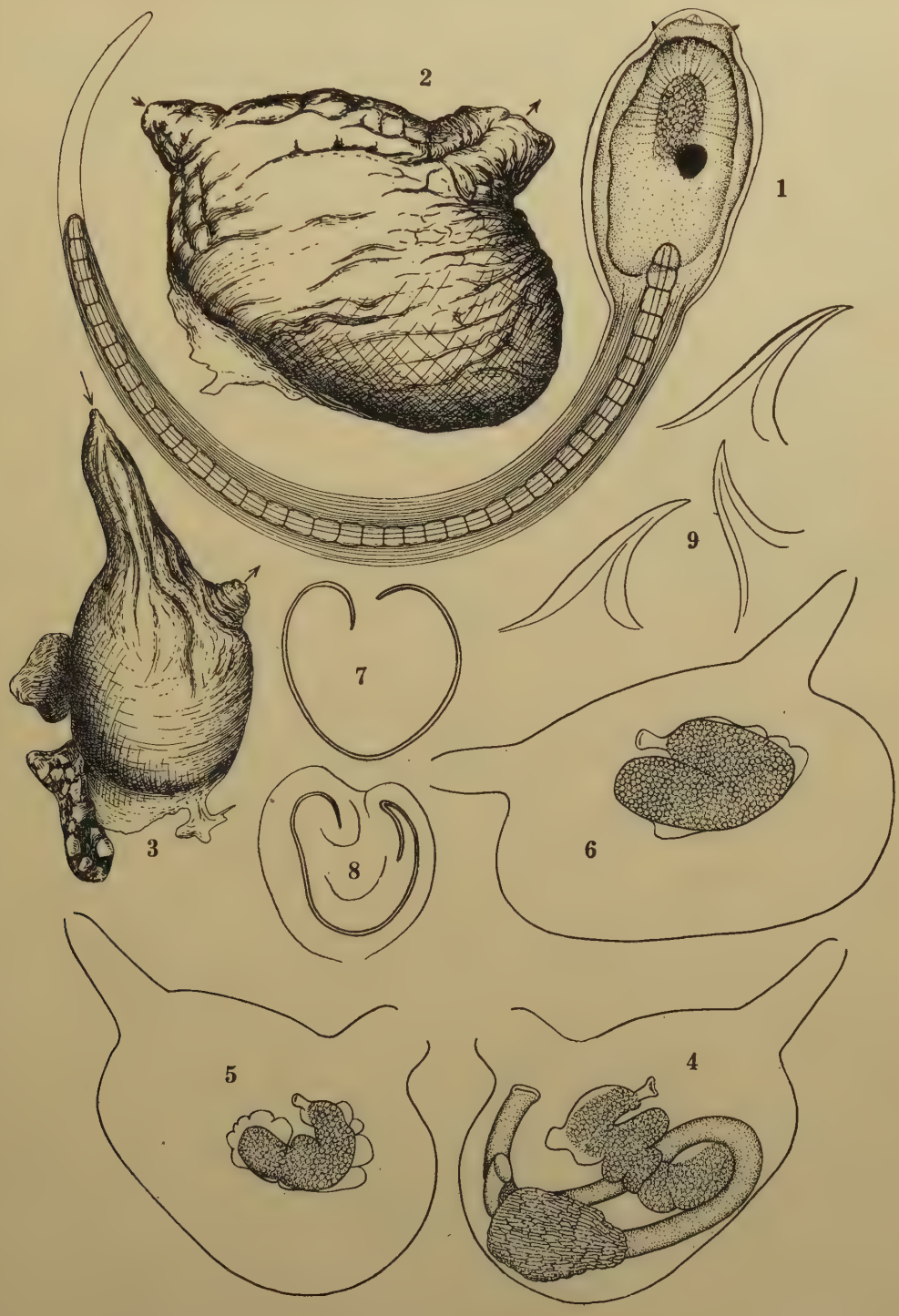
4—Left half of mantle body of individual shown in fig. 2, inside.

5—Right half of mantle body of individual shown in fig. 2, inside.

6—Right half of mantle body of 12 mm long individual, inside.

7, 8—Ciliated grooves, magnified.

9—Spinules from the distal part of stomodaeum. ×1200.



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CORRECTION OF IDENTIFICATION OF STOMATOPODA

Prof. T. KOMAI found out a misidentification of Stomatopoda in my paper "Invertebrate fauna of the intertidal zone of the Tokara Islands IV. Preliminary list of the collection of Brachyura and Stomatopoda" (Publ. Seto Mar. Biol. Lab., III 2, 1953). He taught me kindly that *Gonodactylus glabrous* BROOKS listed in p. 143 should be young individuals of *Gonodactylus spinosocarinatus* FUKUDA.

Gonodactylus spinosocarinatus

FUKUDA, T. (1909): Report on Japanese Stomatopoda with descriptions of two new species, Annot. Zool. Japon., Vol. 7, pp. 143–145, Pl. IV figs. 2 and 2a.

福田　卓 (1909): 日本産口脚類, 動物学雑誌, Vol. 21, No. 244, pp. 54–56, Pl. V figs. 2 and 2 a.

—Takasi TOKIOKA—

A LIST OF FISHES FROM THE TOKARA ISLANDS, KAGOSHIMA PREFECTURE, JAPAN[1)]

Toshiji KAMOHARA
Biological Laboratory, Liberal Arts Faculty, Kôchi University

With 17 Text-figures

During a short tour to the Tokara islands, including the southernmost and northernmost isles, Takarajima and Nakanoshima, Kagoshima Prefecture, in the months of May and June, 1953, I made a small collection of fishes chiefly from the tide pools and partly from the open sea. The collection embraces 124 species. Among them the following 14 species are here recorded for the first time as belonging to the fish-fauna of Japan.

Mugil labiosus Cuvier & Valenciennes (**Mugilidae**) (East Indies and southwards)
Cephalopholis argus Bloch & Schneider (**Serranidae**) (China and southwards)
Plectorhynchus diagrammus (Linné) (**Haemulidae**) (Philippines and southwards)
Anampses twistii Bleeker (**Labridae**) (East Indies and southwards)
Stethojulis trilineata (Bloch & Schneider) (**Labridae**) (Philippines and southwards)
Halichoeres binotopsis (Bleeker) (**Labridae**) (The same distribution)
Halichoeres scapularis (Bennett) (**Labridae**) (Philippines)
Pseudojulis trifasciatus M. Weber (**Labridae**) (East Indies)
Thysanophrys serratus (Cuvier & Valenciennes) (**Platycephalidae**) (Ceylon and southwards)
Bothus mancus (Broussonet) (**Pleuronectidae**) (India and Hawaii)
Solea heterorhina Bleeker (**Soleidae**) (Philippines and southwards)
Tripterygion articeps (Jenkins) (**Blenniidae**) (Hawaii)
Istiblennius edentulus (Bloch & Schneider) (**Blenniidae**) (China and southwards)
Istiblennius cyanostigma (Bleeker) (**Blenniidae**) (Philippines)

Besides those there are 33 species which have not hitherto been recorded from Japan proper including Tanegashima and Yakushima, although they have been recorded from the region from Amami-Oshima to Formosa, and 4 species belonging to the family Blenniidae could not be identified.

1) Scientific Survey of the Tokara Islands, Report No. 9.

The fauna of this district bears close relation to that of Formosa and Philippines, and also to that of Southern Japan. In the main, however, the fauna is tropical, a large proportion of the species being found in Philippines and India. A few of the species of Central Japan extend their range southward to this district. All the drawings are my own work, some of them being drawn from specimens from Prov. Tosa instead of those of the present collection because the latter were too small or multilated.

All the specimens secured are deposited at the Osaka Municipal Natural Science Museum, some of the duplicates being contained at the Biological Laboratory of the Liberal Arts Faculty of Kôchi University.

I present with pleasure my deep obligation to Mr. Yoshitaka TSUTSUI, head of the Scientific Research Party and chief of the Osaka Municipal Natural Science Museum, and I wish to express my profound sense of gratitude to Dr. Shigeho TANAKA, ex-professor of Tokyo University, for his kind encouragement. I am also greatly indebted to Dr. Itirô TOMIYAMA, chief of the Misaki Marine Biological Station of Tokyo University, who helped me in the identification of some species of the families Gobiidae and Blenniidae.

The following list consists of the above-mentioned 124 species of my collection and 21 species which were observed, but not collected.

Synodontidae

Saurida undosquamis (RICHARDSON) Ma-eso Native name : Eso (Takarajima)

Only one specimen, 120 mm long, was collected during the entire period at Takarajima, although the natives claim this species is rather common around the island.

This species is widely distributed in the regions from Southern Japan to Africa and Australia.

Synodus variegatus (LACÉPÈDE) Aka-eso

Color yellowish generally. On back and sides 9 dark crossbands, the center of which is paler. Dorsal and caudal with more or less conspicuous series of brown spots.

One specimen, 82 mm in length, from Takarajima.

This species is widely distributed throughout the Indian and Pacific Oceans. In Japan it ranges as far north as the middle part of Japan.

Congridae

Conger cinereus RÜPPELL Gin-anago Native name: Tokonko (Takarajima)

Characterized by very small pectorals, uniform coloration on head and body, and a marginal black edge to the vertical fins. Pectoral with a black spot. I do not find any evident differences by which *C. nystromi* JORDAN & SNYDER can be separated from *C. cinereus*.

Rather common, especially the young, about 100 mm long, in both islands. Several young from Takarajima. The largest one collected at the same place was slightly over 1,000 mm long.

The species is distributed throughout the Indian Ocean, from Red Sea and Africa to Australia and Polynesia.

Ophichthyidae

Myrichthys maculosus (CUVIER) (Fig. 1) Goishi-umihebi Native name: Umihebi (Takarajima)

M. aki TANAKA

Fig. 1. *Myrichthys maculosus* (CUVIER).

Color yellowish white, with 3 alternating series of brown, round spots, the middle series the largest, the upper and lower series partly extending onto the fins.

Three specimens, 180–270 mm in length, from Takarajima.

This species is distributed throughout the Indian and Pacific Oceans, from Red Sea and Madagascar to Hawaii. In Japan it ranges as far north as Prov. Kii.

Muraenidae

The natives are quite confused over names for most of the species of this family and although they know a great number of names for moray eels, they are often uncertain about using them correctly.

Echidna zebra (SHAW) Zebura-utsubo Native name: Iso-habu (Takarajima)

Tail about twice in head and trunk taken together. Color blackish brown, with about 40 white, black-edged narrow ring-like markings.

Two specimens, about 800 mm long, from Takarajima. The natives fear this moray eel more than all others and kill them whenever possible, whether they want to eat them or not. Actually this eel may be more abundant than the collections indicated.

This species widely ranges in the Indian and Pacific Oceans, from Africa to Samoa. It has been recorded from Okinawa.

E. nebulosa (AHL) Kumo-utsubo Native name: Kidaka (Takarajima)

Color yellowish, with numerous fine vermiculated lines or small spots, and two series of large, reticulated black spots, the upper along the back and the lower along the lower half of body.

Two specimens, about 200 mm long, from Takarajima.

The species is widely distributed in tropical regions in the Pacific and Indian Oceans, from Africa to Polynesia. It has been recorded from Okinawa.

Gymnothorax pictus (AHL) Ase-utsubo Native name: Kidaka (Takarajima)

Color pattern consists of black speckles or tiny black spots on a white background. In specimens 100 mm long the spots on the body occur in 4–6 irregular rows along body; in specimens 150–200 mm long the spots have pale centers; in the large specimens the body becomes speckled with tiny black spots.

Rather common, especially the young 100–200 mm long, in both islands. Two large specimens, 470 and 500 mm long respectively, from Takarajima.

The species is widely distributed in the regions from Africa to Australia and Mexico. It was also found in Japan (Kii and southwards).

G. petelli (BLEEKER) Kurakake-utsubo Native name: Oki-dakame (Takarajima)

Color brown, with about 20 dark crossbands, which are larger than the interspaces between them. The first band on snout, the third through origin of dorsal. It is easily recognizable by the dark crossbands.

One specimen, about 500 mm in length, from Takarajima.

It is known in the regions from Okinawa to the East Indies, Samoa and Hawaii.

G. meleagris (SHAW & NODDER) (Fig. 2) Hanabi-utsubo Native name: Kuro-kidaka (Takarajima)

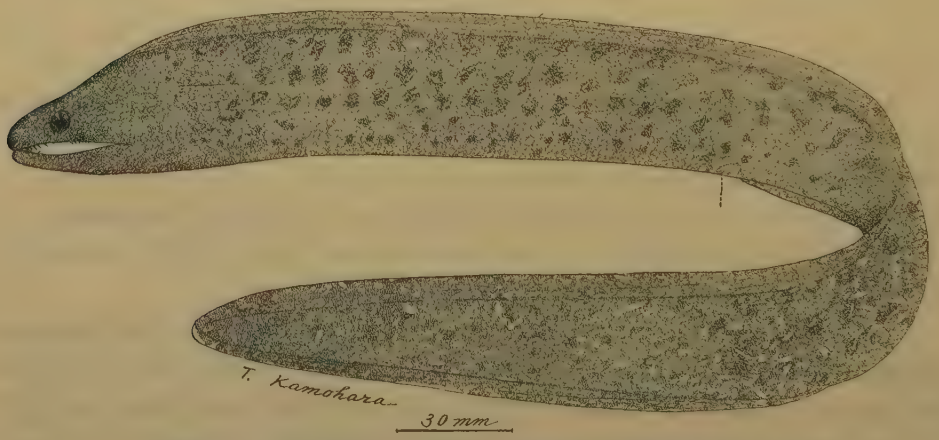

Fig. 2. *Gymnothorax meleagris* (SHAW & NODDER).

Color purplish brown, scattered with small white spots smaller than interspaces. Besides, some five longitudinal rows of black blotches as large as pupil arranged somewhat irregularly overlie the above-mentioned marking on the body. Dr. TANAKA (1908) has indicated this species under the name *G. wakanourae*, but I know of no evident characters to separate it from *G. meleagris*.

Two specimens, about 400 mm long, from Takarajima.

The species is distributed in the regions from Southern Japan to the East Indies, Samoa and Hawaii. In Japan it ranges as far north as Prov. Kii.

G. flavomarginatus (RÜPPELL) Goma-utsubo Native name: Aburame (Takarajima)

Color yellowish, densely covered with blackish spots; these spots may fuse into larger irregular patches, in which case only an yellowish network from the ground-color is left. Vertical fins narrowly margined with white posteriorly. Gill-openings in a dark brown patch.

Four specimens, 160–240 mm long, from Takarajima.

The species is widely distributed throughout the Indian Ocean, from Africa to New Guinea. It was also found in Riu Kiu.

G. undulatus (LACÈPÉDE) Nami-utsubo Native name: Shiro-kidaka (Takarajima)

Color brownish, speckled, spotted and reticulated with white. Anal broadly margined with white.

One specimen, 170 mm in length, from Takarajima.

This species is known in the regions from Riu Kiu to the East Indies, New Guinea, Samoa and Hawaii. I have recorded it from Prov. Tosa.

Syngnathidae

Corythroichthys quinquarius SNYDER Ganten-ishiyōji

Color yellowish brown; sides of body with very small, pearly ocelli in quinqunx order, each with a brown dot at the the center.

Three specimens, about 95 mm in length, from Takarajima.

Hitherto known only from Tanegashima.

Microphis extensus SNYDER Hibashi-yōji

Two strongly denticulated ridges extend from snout to interorbital space. Color purplish brown; caudal dark reddish brown, with bright orange spots.

One specimen, 61 mm long, from Nakanoshima.

Hitherto known only from Naha, Okinawa.

Fistulariidae

Fistularia serrata CUVIER Ao-yagara Native name: Bō-io or Fūgushi (Nakanoshima)

Rather common, but no specimens were collected.

The species is distributed in the regions from the middle part of Japan to the East Indies, New Guinea and Hawaii.

Belonidae

Tylosurus anastomella (CUVIER & VALENCIENNES) Datsu Native name: Nagasai (Nakanoshima)

Rather common. Secured for food with hook and line; not collected.

The species is distributed in the regions from Hokkaido and Korea to Southern China.

Exocoetidae

Cypselurus agoo (TEMMINCK & SCHLEGEL) Tobi-uo Native name: Tobi-uo (both islands)

Common in both islands. One specimen, 300 mm long, from Nakanoshima. The natives are familiar with this species and well aware where they occur around the islands. This is an important food fish for the natives and is taken by drift-nets.

It is known in the regions from Korea to Formosa and reaches Southern Japan.

C. poecilopterus (CUVIER & VALENCIENNES) Aya-tobi-uo Native name: Tobi-uo (both islands)

Rather common in both islands. One specimen, 220 mm long, from Nakanoshima.

The species is widely distributed in the regions from Hokkaido and Fuzan to China, Melanesia and Polynesia.

Atherinidae

Atherion elymus JORDAN & STARKS (Fig. 3) Mugi-iwashi Native name: Zako or Ara-zako (Takarajima)

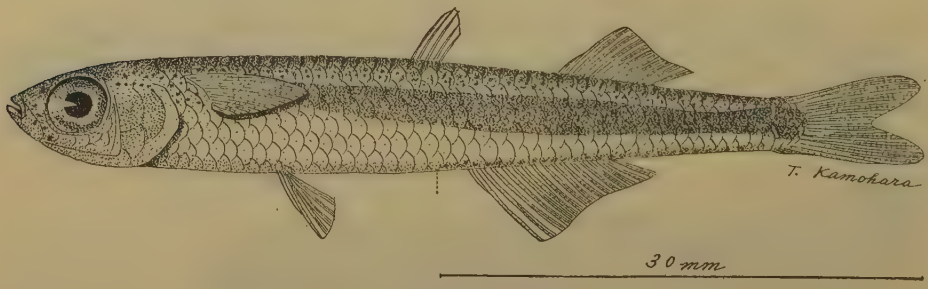

Fig. 3. *Atherion elymus* JORDAN & STARKS.

Common in both islands. Occurs in schools in tide pools. Many specimens, about 55 mm long, from both islands.

Hitherto known in the regions from Prov. Bōshū to Prov. Tosa, and my specimens suggest that the species ranges farther southward to Riu Kiu.

Mugilidae

Mugil cephalus LINNÉ (Fig. 4) Bora Native name: Bora (both islands)

Several young, 37–82 mm long, from both islands.

The species is very widely distributed in almost all the waters of the world.

Fig. 4. *Mugil cephalus* LINNÉ.

M. vaigiensis QUOY & GAIMARD Munaguro-bora (new Japanese name) Native name: Bora (Takarajima)

D. IV–I, 8; A. III, 8; L. 1. 28. Head very broad and flat; no adipose eyelids; caudal subtruncate. Color dark green, ventrally lighter. Characterized by black pectorals, by a pale caudal, and by the pectoral being shorter than the head.

Several specimens, 70–80 mm long, from Takarajima. Found in association with *Dules taeniurus* CUVIER & VALENCIENNES but not so abundant.

The species is widely distributed throughout the Indian Ocean and the tropical waters of the Pacific Ocean. It was also found in Philippines. Dr. J. T. F. CHEN (1952) has recorded it from Formosa. My specimens suggest that this tropical species ranges to Riu Kiu.

M. engeli BLEEKER Nanyō-bora

M. kelaartii GÜNTHER

D. IV–I, 7; A. III, 9; L. 1. ca 33. Posterior adipose eyelid present. Maxillary hidden when mouth is closed. Pectorals slightly shorter than length of head, reaching 9th lateral scale; caudal peduncle about $\frac{3}{7}$ length of head; caudal deeply concave. Color olivaceous, below silvery.

One specimen, 65 mm long, from Takarajima. Dr. ŌSHIMA reports as *M. kelaartii*

GUNTHER from Formosa (Ann. Carnegie Mus., vol. XXX, nos. 3–4, 1922). Dr. FOWLER (1928) states that there is little doubt that *M. kelaartii* is a synonym of *M. engeli*.

It is known in the regions from Formosa to the East Indies, Samoa and Hawaii.

M. labiosus CUVIER & VALENCIENNES Mitsukuchi-bora (new Japanese name)

D. IV–I, 8; A. III, 9; L. l. ca 36. No adipose eyelids. Lower part of upper lip with a shallow groove provided with one series of pointed papillae. Pectorals longer than head; caudal large, emarginate. Color olivaceous above, silvery on sides and below; base of pectoral superiorly with a very small blackish spot.

One specimen, 143 mm long, from Nakanoshima. A rare unexpected fish, whose habitat is the East Indies, Red Sea and Melanesia.

Liza macrolepis (SMITH) Uroko-bora (new Japanese name)

D. III–I, 9; A. III, 9; L. l. 30. Color pale olivaceous, paler below.

One specimen, 140 mm in length, from Takarajima. The specimen before me differs from the descriptions of several authors in having a smaller number (3 instead of 4) of dorsal spines. But judging from the other features it will probably be a variant rather than a distinct species.

The species is known in the regions from Riu Kiu to Africa, Society Islands and Samoa.

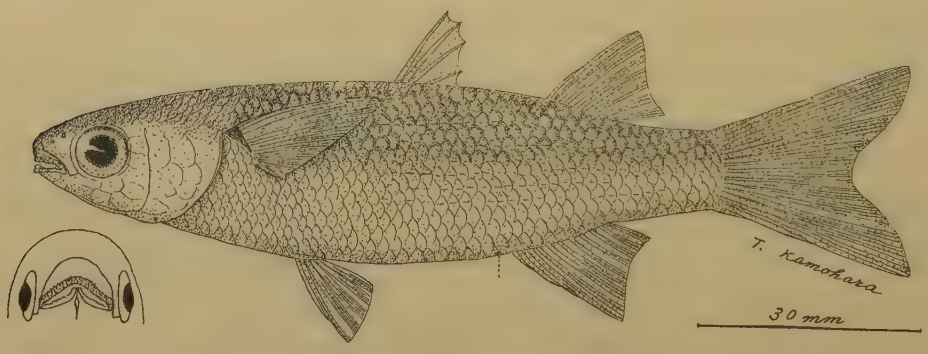

Fig. 5. *Crenimugil crenilabis* (FORSKÅL).

Crenimugil crenilabis (FORSKÅL) (Fig. 5) Fūrai-bora Native name: Bora (Takarajima)

L. l. 39. No adipose eyelids. Soft dorsal and anal scaled over most of fins. Upper lip thick, with several series of small fleshy knobs; lower lip crenulated; caudal deeply emarginate. Color greenish, whitish below; base of pectoral superiorly with a small blackish spot.

Several specimens, 80–120 mm in length, from Takarajima.

This species is widely distributed in the warm waters from the middle part of Japan to Africa.

Holocentridae

Holocentrus lacteoguttatus CUVIER & VALENCIENNES Hoshi-ebisu Native name: Ake-yuo (Nakanoshima)

D. XI, 12; A. IV, 8; L. l. 45. Color reddish generally, covered with irregular minute dusky dots, and with about 10 longitudinal dark streaks. All the fins yellowish; spinous dorsal with a series of black blotches.

One specimen, 85 mm long, from Nakanoshima.

This species is distributed in the regions from Riu Kiu to Africa, New Guinea and Polynesia.

H. ruber (FORSKÅL) Ayame-ebisu Native name: Ake-yuo (Nakanoshima)

Color deep red, paler below; snout with 9 longitudinal streaks, of which the four uppermost are blackish and the rest brownish. Dr. TANAKA states that *H. spinosissimus* TEMMINCK & SCHLEGEL is a synonym of this species.

Three specimens, 120–145 mm long, from Nakanoshima.

The species is known in the regions from Prov. Kii to Red Sea and Samoa.

Katsuwonidae

Katsuwonus pelamys (LINNÉ) Katsuo

The natives said that this species is common off Takarajima but never collected one during the period we were there.

The species is widely distributed throughout the warm waters of all the world.

Auxis thazard (LACÉPÈDE) Hirasōda Native name: Subota (Takarajima)

Rather common. Caught with hook and line; not collected.

The species is widely distributed throughout the warm waters of all the world.

Euthynnus yaito KISHINOUYE Suma

Common. Several specimens, about 400 mm long, were secured with hook and line; not collected.

The species is known in the regions from the middle part of Japan to Korea and Philippines.

Thunnidae

Thunnus thynnus (LINNÉ) (Fig. 6) Maguro

During the period at Takarajima a young, about 400 mm long, was fished with hook and line; not collected. According to the natives this species is rather rarely caught there.

The species is widely distributed throughout the waters of the world, excepting the cold waters.

Fig. 6. *Thunnus thynnus* (LINNÉ). (Young)

Neothunnus macropterus (TEMMINCK & SCHLEGEL) Kihada Native name: Shibi (Takarajima)

Rather common. The natives catch it for food with hook and line called Horobiki and occasionally by spear called Ozuki; not collected.

This species is distributed throughout the warm waters of the Pacific Ocean. In Japan it is found at Hokkaido and southwards.

Cybiidae

Acanthocybium solandri (CUVIER & VALENCIENNES) Kamasu-sawara Native name: Sawara (both islands)

Head and body blue above shading to white on belly. Body with about 30 vertical dusky bars.

Common. Several specimens, about 1 m long, were speared from small boats off Takarajima; not collected. It is one of the main food fishes of the natives.

The species is widely distributed throughout the warm waters of the world.

Sarda chilensis (CUVIER & VALENCIENNES) Hagatsuo Native name: Hagatsuo (Takarajima)

Rather commonly caught with hook and line; not collected.

The species is known in the regions from the central part of Japan and Fuzan to Africa, Australia and the west coasts of North and South America.

Coryphaenidae

Coryphaena hippurus LINNÉ Shiira

Common. The natives catch it with hook and line called Egi. Several large specimens were fished with hook and line from our steamer; not collected. It is one of the main food fishes of the natives.

This species is widely distributed throughout the warm waters of the world.

Cheilodipteridae

Apogon novemfasciatus CUVIER & VALENCIENNES Medama-ishimochi Native name: Tsurigoro (Takarajima); Isoji (Nakanoshima)

Snout rather pointed, its length three-fourths of eye-diameter; height of praeorbital one-third of eye. Color light reddish brown, whitish below, with 5 blackish longitudinal bands about equal to the interspaces.

Rather common in both islands. Several specimens, 60–105 mm long, from both islands.

It is known in the regions from Prov. Kii to Africa, Melanesia, Micronesia and Polynesia.

A. endekataenia (BLEEKER) Kosuji-ishimochi

Native names are the same as those of the species mentioned above.

Snout blunt, its length two-thirds of eye-diameter; height of praeorbital equal to half eye. Color light reddish brown, slightly paler below, with 5–6 blackish longitudinal bands. A rather distinct black spot in the lateral line at base of caudal; pectoral axilla blackish.

Rather common in both islands. Several specimens, about 90 mm long, from both islands.

The species is known in the regions from Southern Japan to Red Sea.

A. erythrinus SNYDER Riū-Kiū-ishimochi

D. VI–I, 10; A. II, 8; L. l. 25. Head 3.1–3.4 in length without caudal; second dorsal spine 2–2.1; gill-rakers on first arch 3+10–13. Mr. EBINA has proposed the name *A. kominatoensis* for this species (Journ. Imp. Fish. Inst., vol. XXX, no. 3, 1934, p. 211, fig. 1), but I scarcely find evident characters to separate his specimen from *A. erythrinus*.

Several specimens, 50–60 mm long, from both islands.

This species is widely distributed in the regions from Kominato, Chiba Prefecture, to Philippines, Polynesia and Hawaii.

Kuhliidae

Dules taeniurus CUVIER & VALENCIENNES Gin-yugoi Native name: Hibana (both islands)

This species is one of the most common fishes in both islands and occurs in large schools in tide pools. Length 20–140 mm.

Widely distributed throughout the Indo-Pacific, from the middle part of Japan to Africa, the Southern Sea and Mexico.

Kuhlia rupestris (LACÉPÈDE) Ōkuchi-yugoi

Found in association with *D. taeniurus* but not as abundant. One specimen, 105 mm long, from Nakanoshima.

This species lives in the waters from Okinawa to Africa, Australia and Polynesia.

K. marginata (CUVIER & VALENCIENNES) Yugoi Native name: Mukyō (Nakanoshima)

Common. Many specimens, 80–150 mm long, were collected in enclosed blackish pools and brooks at Miyazuru in Nakanoshima. Dr. TANAKA states that this species is a synonym of *rupestris*.

Widely distributed throughout the Indo-Pacific, from the middle part of Japan to Africa, Micronesia, Melanesia and Polynesia.

Serranidae

The natives are quite confused over names for most of the species of this family and although they know a great number of names for sea basses, they are often uncertain about using them correctly.

Variola louti (FORSKÅL) Bara-hata Native name: Aka-nebaru (Takarajima)

Several specimens, about 300 mm long, seen in Takarajima, but were dispatched by the natives before they could be preserved. It bites on a hook at night, and is prized for food by the natives.

Widely distributed in the Indo-Pacific, the species has been known from Prov. Tosa, which is probably its northern limit in range.

Cephalopholis argus BLOCH & SCHNEIDER Goma-hata (new Japanese name) Native name: Garasu-chota (Takarajima); Kuro-sebi (Nakanoshima)

Color dark purplish brown; head, body and fins covered with blue small spots ringed with black. Soft dorsal, anal and caudal narrowly margined with whitish.

Solitary individuals live in tide pools. Four specimens, 86–150 mm long, from both islands.

The species was recorded from the regions from China to Africa, New Guinea, Samoa and Hawaii. It was never known from Riu Kiu and Formosa.

Epinephelus summana caeruleopunctatus (BLOCH) Hakuten-hata Native name: Garasunebaru (Takarajima)

Color dark purplish brown, with round whitish spots which extend onto vertical fins. Maxillary groove edged with black.

Three specimens, 90–250 mm in length, from Takarajima.

The species is known in the regions from Riu Kiu to Africa, Australia, Melanesia and Micronesia. Mr. S. MASUDA reports this form from Hamamatsu, Misaki and Okitsu, Chiba Prefecture which is probably its northern limit in range (Annot. Zool. Japon., vol. 21, no. 2, 1942).

E. merra merra BLOCH Kanmon-hata Native name: Watanaga or Chota (Takara-jima); Nebaru or Ara (Nakanoshima)

Common in both islands. Many specimens, 60–240 mm long, from both islands.

Widely distributed in the Indo-Pacific region, from Red Sea to Madagascar, Australia, Polynesia and Hawaii. It was recorded from Okinawa.

E. merra megachir (RICHARDSON) Moyō-hata Native names of this species are the same as those of Kanmon-hata.

Common in both islands. Many specimens, 60–190 mm long, from both islands.

The species is distributed in the regions from Southern Japan to India and Australia.

E. moara moara (TEMMINCK & SCHLEGEL) (Fig. 7) Kue

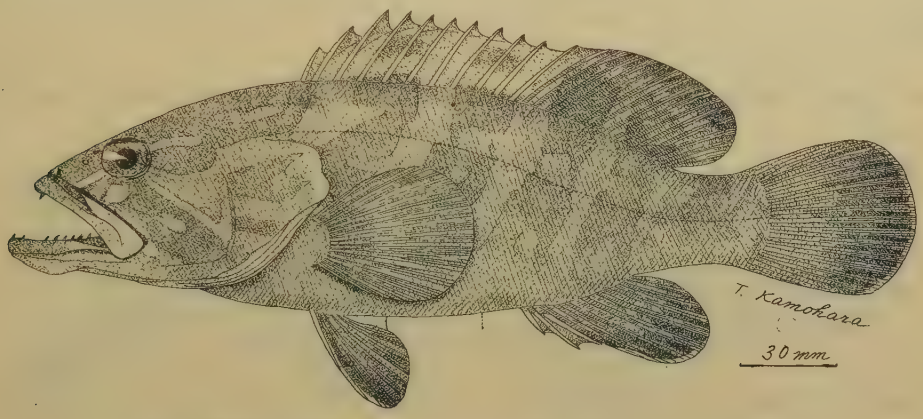

Fig. 7. *Epinephelus moara moara* (TEMMINCK & SCHLEGEL).

A young, 32 mm long, from Takarajima.

The species lives in the waters from the middle part of Japan to Fuzan and Hong-Kong.

Pseudanthias taira SCHMIDT Riū-Kiū-hanadai

A young, 26 mm long, from Nakanoshima.

Hitherto known only from Amami-Ōshima.

Grammistes sexlineatus (THUNBERG) Nunozarashi Native name: Egu-yuo (Takara-jima)

Dorsal fins separate. Color dark brown generally, with several broad longitudinal yellowish bands.

Solitary individuals live in tide pools. Rather common. Several specimens, 60–90 mm long, from both islands.

Widely distributed in the tropical waters from Africa to Polynesia, the species extends as far north as Prov. Kii, Japan.

Pharopterycidae

Plesiops oxycephalus BLEEKER Nakahara-tanabata-uo

Several specimens, 60–70 mm long, from Takarajima.

Distributed in the regions from Southern Japan to the East Indies.

Lutianidae

Pristipomoides sieboldi (BLEEKER) (Fig. 8) Chibiki Native name: Aka-matsu (Takarajima); Matsudai (Nakanoshima)

Common. Fished with hook and line, but not collected. It is one of the main food fishes of the natives.

The species lives in the waters from the middle part of Japan to Riu Kiu and Hawaii.

Fig. 8. *Pristipomoides sieboldi* (BLEEKER).

Etelis carbunculus CUVIER & VALENCIENNES Hamadai Native name: Onaga (Takarajima)

Rather common. The natives catch it with hook and line and value it for food; not collected.

This species is widely distributed in the tropical seas, from Madagascar to Australia and Hawaii, and also in the Atlantic Ocean. It ranges as far north as the middle part of Japan.

Lutianus fulviflamma (FORSKÅL) Montsuki Native name: Shūbi (both islands)

Characterized by a large diffuse blackish blotch on lateral line below soft dorsal origin.

Rather common in both islands. Young of this species occur in small schools in tide pools. Several specimens, 100–200 mm long, from both islands.

It is known in wide regions from Southern Japan and Fuzan to Africa, Australia and Polynesia.

L. vaigiensis (QUOY & GAIMARD) Dokugyo

One specimen, 162 mm long, from Takarajima.

Widely distributed in the seas from Southern Japan to Africa, Australia and Polynesia.

Haemuridae

Paracaesio caeruleus (KATAYAMA) Aodai Native name: Ao-matsu (Takarajima)

Rather common. Fished with hook and line; not collected. It provides an important food for the natives.

The species was recorded from the regions from Prov. Kii to Kagoshima and Hachijōjima.

Plectorhynchus diagrammus (LINNÉ) Suji-korodai (new Japanese name) Native name: Kokore (Nakanoshima)

Color yellowish gray generally, with 6 longitudinal dark brown bands.

One specimen, 165 mm in length, from Nakanoshima.

This species is known in the regions from Philippines to Africa, Melanesia, Micronesia and Polynesia. It has not hitherto been recorded from Riu Kiu and Formosa.

Scolopsis bilineatus (BLOCH) Futasuji-tamagashira

Color brownish olive, golden below. Two margaritaceous stripes, running from above eye and from hindborder of eye, parallel to each other, to base of soft dorsal. A third much broader band from snout below eye to end of dorsal.

Small schools observed in tide pools. Four specimens, 105–117 mm long, from Nakanoshima.

The species lives in the seas from Riu Kiu to India (Andaman Islands) and Melanesia.

Sparidae

Pagrosomus major (TEMMINCK & SCHLEGEL) Madai

According to the natives this species is rather common near Takarajima. Fished with hook and line; not collected.

The species is distributed in the regions from Hokkaido to Southern China and Hawaii.

Kyphosidae

Girella mezina JORDAN & STARKS Okina-mezina Native name: Kuro-io (young), Subatsu (adult) (Takarajima); Shitsuo (Nakanoshima)

Readily known from related species by having a conspicuous crossbar of yellowish white on the middle of body. Small schools or scattered individuals present in tide pools.

Common in both islands. Numerous specimens, 30–200 mm long, from both islands.

The species is known in the regions from Chiba Prefecture to Canton.

G. punctatus GRAY Mezina Native name: Kure-yuo (Nakanoshima)

Rather common in tide pools in both islands. Three specimens, 50–150 mm long, from Nakanoshima.

It is known in the regions from Hokkaido and Fuzan to Philippines and Canton.

Mullidae

Pseudupeneus fraterculus (CUVIER & VALENCIENNES) Hōrai-uo Native name: Kata-yasu (Nakanoshima)

Several young, 40-55 mm long, from the rock pools in both islands.

The species is known in the regions from Tokyo to Africa.

Aplodactylidae

Goniistius zonatus (CUVIER & VALENCIENNES) (Fig. 9) Takanoha

One specimen, 140 mm long, from Nakanoshima.

The species lives in the seas from the middle part of Japan and Fuzan to Southern China.

Fig. 9. *Goniistius zonatus* (CUVIER & VALENCIENNES).

Cirrhitidae

Cirrhites pinnulatus (BLOCH & SCHNEIDER) Shirohoshi-gombe Native name: Gabu (Takarajima)

D. X. 11; A. III, 6; L. l. 38–40. Head 2.5 in length without caudal; depth 2.7–2.8; eye 4.5 in head. Preopercle margin finely serrate. Scales on cheeks minute, in about 20 transverse rows; interopercle with small scales. Eyes subequal to interorbital space, which is concave. Maxillary reaching to below middle of eye; nostrils close together, the anterior one with a posterior flap, which is fringed at the top. Color violet-gray; head and body with numerous reddish brown spots; large white blotches on side, more or less regularly arranged in rows.

Three specimens, 145–156 mm long, from Takarajima.

This Indo-Pacific species has been known from Prov. Kii, Japan northwards.

Pseudochromidae

Pseudochromis cyanotaenia BLEEKER Riū-Kiū-nise-suzume

Color purplish blue; the lower half of head, breast and paired fins lemon yellow in sharp contrast with the blue on the rest of body.

Four specimens, 45–48 mm long, from Nakanoshima.

This species is known from the regions from Riu Kiu to the East Indies and Australia.

P. xanthochir BLEEKER Kibire-nise-suzume

Color buff brown generally. Dorsal and caudal yellowish; pectoral, ventral and anal pinkish.

Three specimens, 43–57 mm long, from Nakanoshima. It is known in the regions from Riu Kiu to India.

Pomacentridae

The natives have names for some of the species of this family but most of the pomacentrids have no names. Kunobera, Munadaka and Heki are general names referred to some species in Takarajima, but the natives are not sure for just how many damsel fishes these terms are correct.

Abudefduf notatus (DAY) Iso-suzumedai Native name: Kunobera (Takarajima); Hitsuo (Nakanoshima)

Characterized by 5 pale vertical bands on body.

Common in both islands. Several specimens, 80–130 mm long, were secured.

The species lives in the seas from the middle part of Japan to India.

A. septemfasciatus (CUVIER & VALENCIENNES) Shichisen-suzumedai Native name: Munadaka (Takarajima); Unadaka (Nakanoshima)

Color lemon yellow, with 7 blackish crossbands which are wider than interspaces between them. Spinous dorsal margined with brownish; base of caudal with a black spot superiorly.

Common in both islands. Many specimens were secured. Length 70–150 mm.

Widely distributed in the regions from Okinawa to Africa, Melanesia, Micronesia and Polynesia.

A. uniocellatus (QUOY & GAIMARD) Ichimon-suzumedai

Color chocolate brown generally. Dorsal with one black blotch at the base of posterior rays.

Common in both islands. Numerous specimens, 70–80 mm long, were secured.

Widely distributed in the seas from Riu Kiu to India, Australia, Micronesia and Polynesia.

A. albifasciatus (HAMBRON & JACQUINOT) Miyako-suzumedai

Color olivaceous generally, with 3 yellowish vertical bands; cheek with a yellowish spot.

Common in both islands. Many specimens were secured. Length 50–70 mm.

Distributed in the warm seas from Riu Kiu to India.

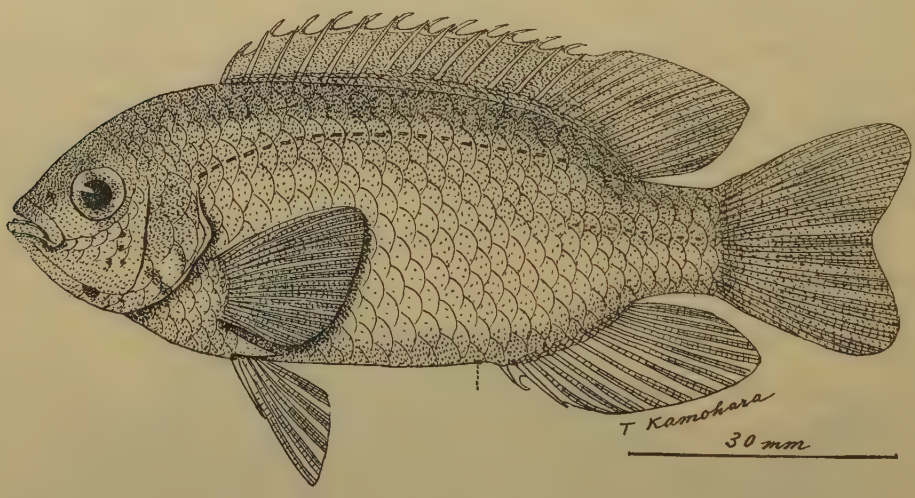

Fig. 10. *Abudefduf glaucus* (CUVIER & VALENCIENNES).

A. glaucus (CUVIER & VALENCIENNES) (Fig. 10) Nezu-suzumedai Native name: Mehage (Takarajima)

Color yellowish gray generally; spinous dorsal with a submarginal longitudinal pale streak; vent blackish.

Common in both islands. Small schools present in tide pools. Many specimens, 80–100 mm long, were secured.

Occurs in the seas from Misaki, Kanagawa Prefecture to India, Melanesia, Micronesia and Polynesia. Recently I have collected the fish at Okinoshima Island, Prov. Tosa.

A. yamashinai OKADA & IKEDA Yamashina-suzumedai Native name: Kunobera. (Takarajima)

Color chocolate brown generally, paler below; a white band covering three series of scales passing across the body from base of sixth, seventh and eighth dorsal spines to front of vent; upper edge of pectoral with a black spot.

Rather common. Many specimens. 70–110 mm long, from Takarajima.

Hitherto known only from Miyakojima, near Formosa.

A. leucozonus (BLEEKER) Hakusen-suzumedai

Color yellowish brown, with a white vertical band descending from sixth, seventh and eighth dorsal spines; a large black ocellus edged with white at base of last three dorsal spines, above the lateral line; another black spot on back of tail immediately after dorsal fin; a small one superiorly at base of pectoral.

Two specimens, 25 and 52 mm long respectively, from Takarajima.

The species lives in the seas from Chiba Prefecture to the East Indies and Polynesia.

A. cyaneus (QUOY & GAIMARD) Tsumaguro-ruri-suzumedai

Color deep gray-blue generally; each scale with narrow light blue basal spot; vertical fins margined with dusky brown.

One specimen, 61 mm long, from Takarajima.

The species is widely distributed in the seas from Riu Kiu to the East Indies and the Southern Sea.

A. biocellatus (QUOY & GAIMARD) Kinran-suzumedai

Color brown, paler below. A band of azure blue extends from upper edge of eye to the black ocellus on last dorsal spines; another small black ocellus at base of last dorsal rays.

Two specimens, 16 and 45 mm long respectively, from Takarajima; another two, 17 and 29 mm long respectively, from Nakanoshima.

Known in the regions from Tanegashima to Red Sea and Africa.

A. richardsoni SNYDER Okinawa-suzumedai

Scales in longitudinal series 27; 3 above lateral line, 9 below. Color yellowish brown, paler below. Each lobe of caudal with a broad blackish longitudinal band marginally, the upper extending to the base of last dorsal ray, the lower running along caudal peduncle. Spinous dorsal blackish; soft dorsal and anal margined with blackish.

One specimen, 39 mm long, from Takarajima.

Hitherto known only from Okinawa.

A. sexfasciatus LACÉPÈDE Rokusen-suzumedai Native name: Heki (Nakanoshima)

Color grayish, with 5 blackish vertical bands, not quite to lower body edge.

One specimen, 80 mm long, from Nakanoshima.

Widely distributed in the seas from Suruga Bay to Africa, Australia and Polynesia.

A. sordidus (FORSKÅL) Shima-suzumedai Native name: Munadaka (Takarajima)

Color olivaceous brown, whitish below. Seven paler vertical streaks, whitish in young, not more than 1 or 2 scales wide and much narrower than darker intervening bands. A black spot present at pectoral base; another larger black spot present on upper front of caudal peduncle.

Common in Takarajima. Many specimens were collected there. Length 100–200 mm.

Widely distributed in the waters from the middle part of Japan to Red Sea, Australia, Polynesia and Hawaii.

A. saxatilis (LINNÉ) Oyabitcha Native name: Ayabiki (Takarajima); Madara-heki (Nakanoshima)

Color dark gray, lighter below. Side of body with 6 broad blackish vertical bands becoming indistinct below.

Common in both islands. Many specimens were secured. Length 50–130 mm.

Widely distributed in the regions from the middle part of Japan to Africa, Australia and Polynesia. It is also known from the West Indies.

Pomacentrus coelestis JORDAN & STARKS Sora-suzumedai

A very rare and handsome species. Solitary individual very rarely seen in Nakanoshima; not collected.

Recorded from the regions from the middle part of Japan to Riu Kiu.

Labridae

The largest fish family and certainly one of the most conspicuous groups at Takarajima is the Labridae. The natives have names for some of the species. Nobosu is a general name referred to some species, but they are not sure for just how many fishes this term is correct.

Anampses caeruleo-punctatus RÜPPELL (Fig. 11) Buchi-susuki-bera Native name: Nobosu (Takarajima)

Three specimens, 108–140 mm long, from Takarajima; another one, 45 mm long, from Nakanoshima.

Widely distributed throughout the Indo-Pacific, from Africa to Polynesia. In Japan it extends as far north as Prov. Kii.

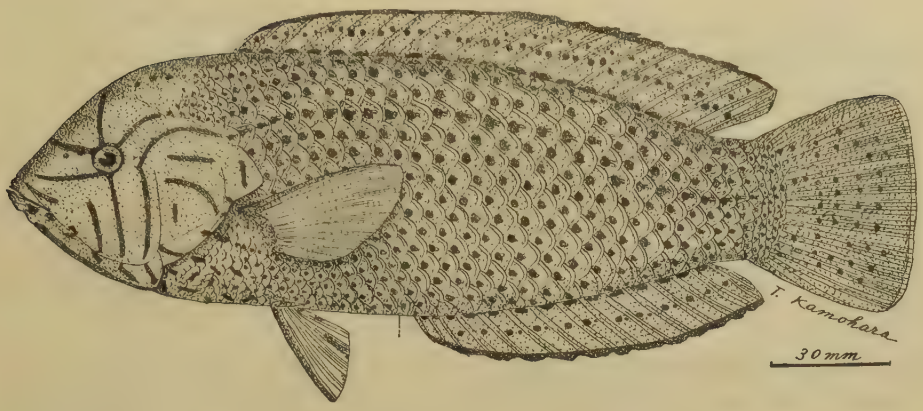

Fig. 11. *Anampses caeruleo-punctatus* RÜPPELL.

A. twistii BLEEKER Hoshi-susuki-bera (new Japanese name)

L. 1. 29. Caudal rounded. Color reddish green; fins yellowish; soft dorsal and anal with a small round black ocellus posteriorly, much smaller than eye; a light brown patch as large as pupil at base of middle caudal rays.

One young, 34 mm long, from Nakanoshima, and five, 25–39 mm long, from Takarajima, are referred with considerable doubt to this species.

The species has been known in the regions from the East Indies and Mauritius. For once from Japan.

Stethojulis axillaris (QUOY & GAIMARD) Kurohoshi-bera Native name: Ama-yuo (Takarajima)

Color yellowish brown. One to three small black ocelli at the middle part of caudal base.

Several specimens, 60–105 mm in length, from both islands.

The species is widely distributed in the regions from Riu Kiu to Red Sea, Africa, Australia, Samoa and Hawaii.

S. trilineata (BLOCH & SCHNEIDER) Oni-bera (new Japanese name)

Color bluish brown, with 3 longitudinal reddish bands, the second from tip of snout to axil of pectoral.

Two specimens, 135 and 140 mm long respectively, from Takarajima.

It has been known in the regions from Philippines to Red Sea. For once from Japan.

S. phekadopleura (BLEEKER) Niji-bera

Color reddish brown, paler below. Red streak along body at level of pectoral base; pale longitudinal series of spots on lower half of body; dorsals finely dotted with grayish.

Five specimens, 80–125 mm long, from Takarajima.

Distributed in the regions from the middle part of Japan to the East Indies, Australia and Polynesia.

S. kalosoma (BLEEKER) Kaminari-bera

Color brown above, finely vermiculated, spotted or varied with darker. Lower half of body pale, with longitudinal rows of small white spots. Dorsal with oblique blue streaks.

A single specimen, 63 mm long, from Takarajima.

The species is distributed in the regions from the middle part of Japan and Fuzan to Africa, Red Sea, Australia and Polynesia.

Halichoeres centriquadrus (LACÉPÈDE) Tokara-bera (new Japanese name)

Opercle above and postocular scaly. Color yellowish brown, pale below; an yellow spot below front dorsal spines on the back and another at front of soft dorsal. Each scale on back with a dark vertical bar.

Several specimens, 70–190 mm long, from Takarajima.

Recorded from the regions from Formosa to Africa and Samoa.

H. margaritaceus (CUVIER & VALENCIENNES) Aka-niji-bera Native name: Yasena (Takarajima)

Color bluish brown, pale below, with several dark brown blotches on back and sides. A large reddish blotch at the middle part of the side of body. A dark spot, less than pupil, behind eye. Dorsals pale, with brown waved vertical bands; a small black ocellus at front of spinous dorsal and a larger one at front of soft dorsal.

Rather common in both islands. Several specimens, 70–100 mm long, were collected.

Distributed in the seas from Okinawa to Africa, Australia and Samoa.

H. nebulosus (VALENCIENNES) Inazuma-bera (new Japanese name)

Color bluish brown, with several ill-defined dark brown blotches on the side of body. Dorsal with a marginal and a basal row of yellow spots. A dark spot behind eye, larger one on opercle. Black spot, as large as eye, at front of soft dorsal.

Rather common in both islands. Many specimens, 105–140 mm long, were collected.

Widely distributed in the seas from Riu Kiu to Red Sea, Australia and Samoa.

H. trimaculatus (QUOY & GAIMARD) Mitsuboshi-kyūsen

Color yellowish gray; each scale with subterminal dark vertical streak. Dusky blotch at fifth or sixth scale of lateral line and another one at upper side of caudal peduncle above lateral line.

Rather common in both islands. Many specimens, 77–143 mm long, were collected.

Known in the regions from Riu Kiu to the East Indies, Micronesia and Samoa.

H. prosopeion (BLEEKER) Munaten-bera

Characterized by a large black basal pectoral spot and by dorsals and anals with longitudinal blue lines.

One specimen, 100 mm long, from Takarajima agrees entirely with specimens from the East Indies and New Guinea. The species extends as far north as Prov. Kii.

H. notopsis (CUVIER & VALENCIENNES) Hakusen-bera Native name: Kuro-nobosu (Takarajima)

Color blackish brown generally. About 6 white longitudinal lines inconspicuous in large specimens. Black ocellus, larger than eye, at front of soft dorsal; caudal white.

Common in both islands. Many specimens, 50–120 mm long, were collected. Three small specimens, about 10 mm long, from Nakanoshima seem to be referable to this species.

The species lives in the seas from Okinawa to India, Australia and Samoa.

H. binotopsis (BLEEKER) Ami-bera (new Japanese name)

Color bluish gray, reticulated with dark brownish; a black red-edged spot at caudal base above. Dorsal with two black red-edged spots, the first between first and second spines and the second between first and third rays.

One specimen, 67 mm long, from Nakanoshima.

Distributed in the seas from Philippines to the East Indies. First Japanese record.

H. scapularis (BENNETT) Seiten-bera (new Japanese name)

H. cymatogrammus JORDAN & SEALE

D. IX, 13; A. III, 11; L. l. 28. Caudal slightly rounded. Color yellowish green; a distinct dark brown band, slightly wider than pupil, from posterior margin of eye to base of caudal; a bluish brown patch between eye and upper lip; fins yellowish without markings.

Two specimens, 45 and 75 mm in length respectively, from Takarajima.

Hitherto known only from Philippines. This is one of an unexpected addition to the Japanese fish-fauna.

Coris imbris TANAKA Shike-bera Native name: Hanbun-nobosu (Takarajima)

This species is well figured and exactly described by Dr. TANAKA (Fig. Descr. Fish. Jap., vol. 29, 1918, pl. CXXXVIII, fig. 386).

Rather common in both islands. Several specimens, 130–170 mm long, were collected.

Hitherto known only from Tosa and Kii; the locality of my specimens suggests that this species extends in distribution as far south as Riu Kiu.

Pseudojulis trifasciatus M. WEBER Misuji-bera (new Japanese name)

D. VIII, 13; A. III, 11; L. l. 27. Caudal truncate. Color light reddish. A dark band from tip of snout to upper part of caudal base; a second median dark band from between eyes along dorsal base including inferior part of the fin. A black ocellus superiorly at base of pectoral.

Two specimens, 51 and 60 mm long respectively, from Takarajima.

This East Indian species is an unexpected addition to the Japanese fish-fauna.

Thalassoma lutescens (SOLANDER) Yamabuki-bera Native name: Nobosu (Takarajima)

Characterized by head with 5 longitudinal brown bands and by pectoral with a broad black terminal blotch.

Three specimens, 130–200 mm long, from Takarajima.

Widely ranged in the Indo-Pacific, from the East Indies to Australia, Polynesia and Hawaii; the species has been known from Suruga Bay northwards.

T. umbrostigma (RÜPPELL) Kinu-bera Native name: Shūbingenta or Aomata-kusabi (Takarajima); Kusabi (Nakanoshima)

Black spots on head; short vertical black lines on scales; green longitudinal band on the middle of soft dorsal and soft anal fins.

Common wherever there is coral growth at both islands. They are secured with hook and line by the natives, occasionally the adults are speared. Many specimens, 30–190 mm long, were collected.

Widely ranged in the seas from Okinawa to Red Sea, Africa, Australia, Polynesia and Hawaii.

T. cupido (TEMMINCK & SCHLEGEL) Nishiki-bera

Native names of this species are the same as those of the above-mentioned species.

Rather common in both islands. Several specimens, 50–120 mm long, were collected. Dr. TANAKA states that this species is a synonym of *T. umbrostigma*, but this is at once distinguished from the latter by the large black blotch of caudal fin.

The species is known in the regions from the middle part of Japan to the East Indies.

T. hardwicke (BENNETT) Senasuji-bera

Characterized by 6 vertical black bands on body. Two specimens, 61 and 64 mm long respectively, from Takarajima.

The species lives in the tropical seas, from Africa to Polynesia, extends as far north as Prov. Tosa, which is probably its north limit in distribution.

T. jansenii (BLEEKER) Yansen-nishiki-bera

D. VIII, 13; A. II, 11; L. 1. 26. Color gray, paler below, with 3 saddle-like brown blotches; the first on head above and predorsal; the second across spinous dorsal; the third and last from soft dorsal to posterior part of anal; caudal peduncle light.

One specimen, 93 mm long, from Takarajima.

Widely distributed in the seas from Okinawa to Africa, Australia and Polynesia.

Scarichthyidae

Leptoscarus japonicus (CUVIER & VALENCIENNES) Budai Native name: Akahachi (Takarajima); Akabachi (Nakanoshima)

Rather common in both islands. Several individuals, about 500 mm long, seen; not collected.

This species lives in the seas from the middle part of Japan and Fuzan to the East Indies and Hawaii.

Callyodon ovifrons (TEMMINCK & SCHLEGEL) Ao-budai Native name: Aohachi (Takarajima); Aobachi (Nakanoshima)

Rather common in both islands. Several individuals, about 500 mm long, seen; not collected.

Hitherto known only from Southern Japan.

Chaetodontidae

Chaetodon collaris BLOCH Chōchō-uo

The natives say this species is rather common at Takarajima, although only a few individuals were observed during our investigation; not collected.

The species is known in the regions from the middle part of Japan and Fuzan to Red Sea, Madagascar and Micronesia.

C. lunula (LACÉPÈDE) Tsuki-chōchō-uo Native name: Kashira-butsu (Takarajima)

Color brownish generally. A black blotch includes eye, interorbital and cheek,

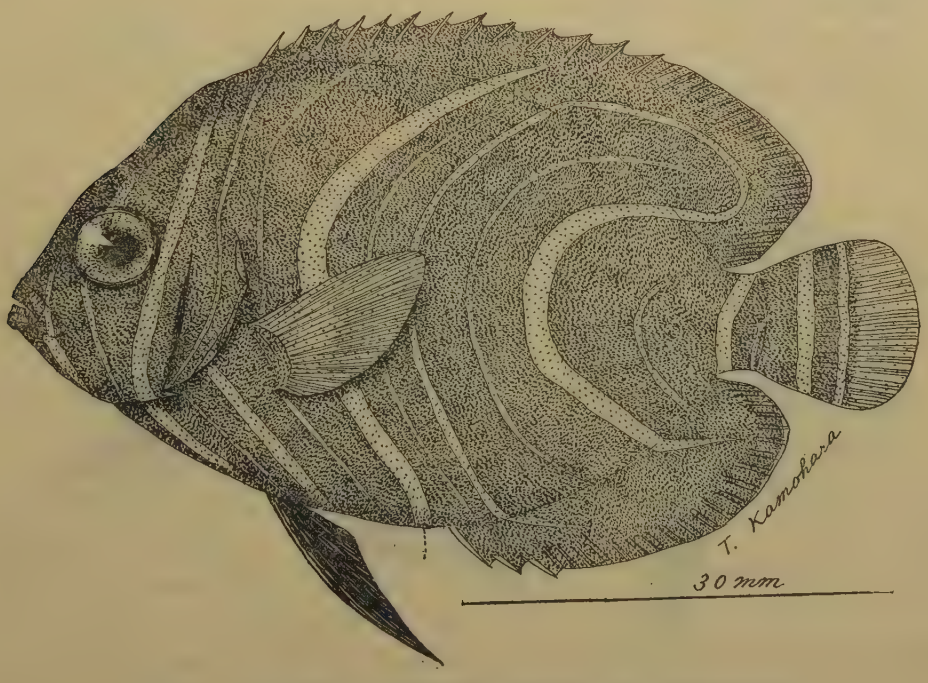

Fig. 12. *Holacanthus semicirculatus* CUVIER & VALENCIENNES.

edged with white; a black band from suprascapula to spinous dorsal base, edged widely whitish.

Three specimens, about 110 mm long, from Takarajima.

The species is distributed in the seas from Misaki, Kanagawa Prefecture to Red Sea.

Holacanthus semicirculatus CUVIER & VALENCIENNES (Fig. 12) Sazanami-yakko

Two young, about 60 mm long, from Takarajima.

Widely distributed in the seas from Prov. Izu to Africa, Australia and Polynesia.

Microcanthus strigatus (CUVIER & VALENCIENNES) Kagokaki-dai

Characterized by 5 broad longitudinal black bands.

A single young, 45 mm long, from Takarajima. Distributed in the waters from the middle part of Japan and Fuzan to Australia and Hawaii.

Hepatidae

Hepatus triostegus (LINNÉ) Shima-hagi Native name: Nenomushi (Takarajima); Yacha (Nakanoshima)

Characterized by 4 vertical brown bands on body.

Common in both islands. Several specimens, 100–150 mm long, were collected.

The species is widely distributed in the regions from the middle part of Japan to Madagascar, Australia, Polynesia and Hawaii.

H. elongatus (LACÉPÈDE) (Fig. 13) Naga-niza Native name: Kōsoku (Takarajima)

Color solid brown generally. Two black spots at dorsal and anal bases.

Two specimens, 100 and 180 mm long respectively, from Takarajima.

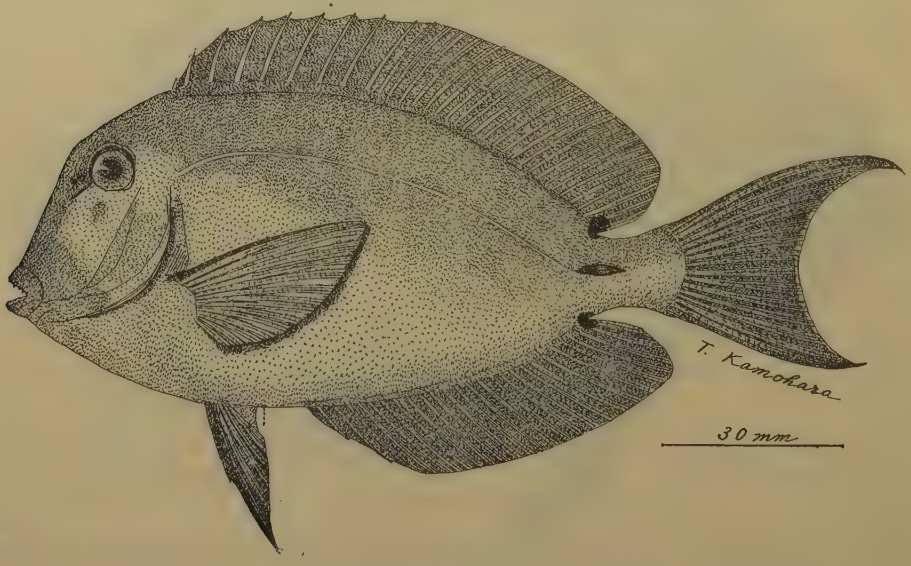

Fig. 13. *Hepatus elongatus* (LACÉPÈDE).

It was recorded from the regions from Prov. Kii to the East Indies, Melanesia, Polynesia and Hawaii.

H. fuliginosus (LESSON) Kuro-hagi

Two specimens, about 100 mm long, from Takarajima.

The species lives in the seas from Misaki, Kanagawa Prefecture to Africa, Australia, Polynesia and Hawaii.

Naso unicornis (FORSKÅL) Tengu-hagi Native name: Tsunogōme (Nakanoshima)

The natives spear the fish with a single or three-pronged spear called Ozuki; not collected.

The species is known in the regions from the middle part of Japan to Red Sea, Melanesia and Hawaii.

Monacanthidae

Osbeckia scripta (OSBECK) Sōshi-hagi Native name: Hōke (Nakanoshima)

The natives catch the fish for food with hook and line and occasionally by spear. One seen, but not collected.

The species is a tropical fish of the world.

Diodontidae

Diodon holacanthus LINNÉ Harisenbon Native name: Igafuku (Takarajima); Igabuku (Nakanoshima)

One specimen, about 150 mm long, from each island.

The species is widely distributed throughout the warm waters of the world.

Scorpaenidae

Sebastichthys oblongus (GÜNTHER) Takenoko-mebaru

Rather common in both islands. Many specimens, 55–90 mm long, were collected.

This species has hitherto been found in the regions from Hokkaidō to Nagasaki and Korea. The locality of my specimens suggests that it may extend as far south as Riu Kiu.

Scorpaena neglecta neglecta TEMMINCK & SCHLEGEL Fusa-kasago

Two specimens, 83 and 91 mm long respectively, from Takarajima.

The species has been recorded from the regions from Yokohama to Kagoshima and Fuzan. The locality of my specimens suggests that it ranges farther southward to Riu Kiu.

Scorpaenodes guamensis (QUOY & GAIMARD) Iso-kasago Native name: Angō Takarajima); Aguro (Nakanoshima)

Common in both islands. The natives fear the fish as being venomous. Many specimens, 50–105 mm long, were collected.

Widely distributed in the seas from the middle part of Japan to Red Sea, Australia, Polynesia and Hawaii.

Synanceja verrucosa (BLOCH & SCHNEIDER) Oni-daruma-okoze (new Japanese name) Native name: Angō (Takarajima)

Ventral rays I, 5; the fin entirely adnate. No transverse ridge present between eyes; interorbital space deeply concave. A deep depression present below eye and a similar but larger one behind. Mouth vertical; lips finely fimbriated with small dermal cirri. Orbit elevated above general upper profile of head; eye directed upward and outward. Color dark brown with two transverse white bands on side of body; caudal whitish, brown basally, with a broad brown terminal band; pectoral, ventral and anal narrowly edged with white.

One specimen, 150 mm long, from Takarajima.

Hitherto known in the regions from Okinawa to the East Indies, New Guinea and Samoa.

Pterois radiata CUVIER & VALENCIENNES Kimi-okoze Native name: Mino-yuo (Takarajima)

Three young, about 100 mm in length, from Takarajima.

Widely distributed in the seas from Prov. Kii to Africa, Micronesia, Polynesia and Hawaii.

Amblyapistus taenianotus (CUVIER) (Fig. 14) Tsumajiro-okoze

One specimen, 80 mm long, from Takarajima. The natives know very little about this species and could not recall no name for it.

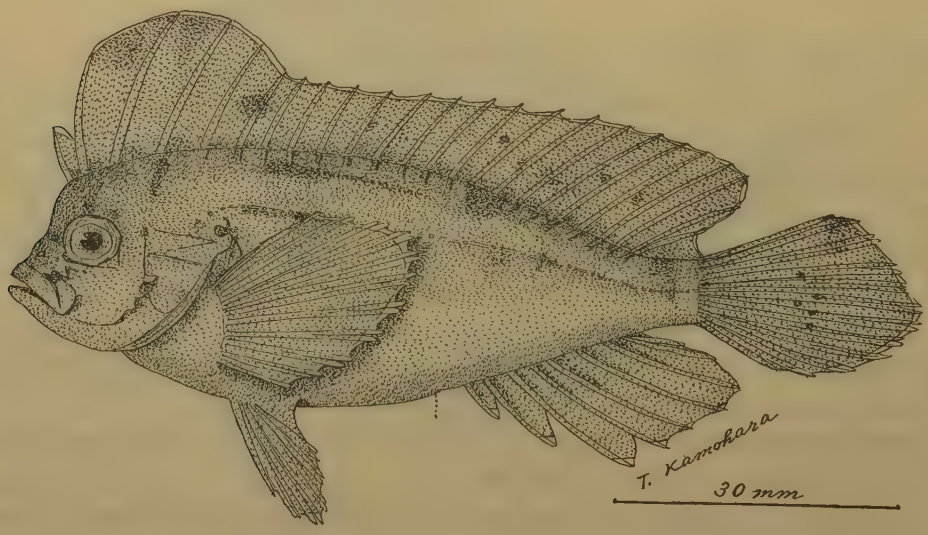

Fig. 14. *Amblyapistus taenianotus* (CUVIER).

It has been recorded from the regions from Mauritius, India, the East Indies, Melanesia and Polynesia. I have reported it from Prov. Tosa (Repts. Kochi Univ. Nat. Sci., no. 2, 1952). Recently it has been collected in Prov. Kii by Dr. UTINOMI of the Seto Marine Biological Laboratory of Kyoto University.

Platycephalidae

Thysanophrys serratus (CUVIER & VALENCIENNES) Hime-gochi (new Japanese name)

D. VIII–12; A. 11; L. l. ca 60. Crests on head and suborbital serrated, without spines; lateral line smooth. Color reddish brown, with 6 irregular vertical brown bands. Top of dorsal with a large brown blotch.

One specimen, 114 mm long, from Takarajima is referred with some doubt to this species.

The species has hitherto been recorded in the seas of the East Indies, Ceylon, Melanesia and New Ireland. The first record from Japan.

Pleuronectidae

Bothus mancus (BROUSSONET) Mon-daruma-garei (new Japanese name) Native name: Oyanerami or Sunakaburi (Takarajima)

D. 90 (smaller specimen)–99; A. 65 (smaller specimen)–76; P. 9–11; L. l. ca 90. Body sinistral, ovate; eyes well separated; whole head scaly; caudal pointed. Color pale brownish, everywhere mottled with gray and brown. Head and body with rounded bluish spots edged with darker; a diffuse dark blotch at the junction of straight and curved parts of lateral line, another on middle of straight portion. Right side of body whitish, without any markings.

Three specimens, 120–155 mm in length, from Takarajima. This fish hides in the sand or in holes during the day and seems to come out to feed at night.

It is known from India, the East Indies, Hawaii and Cocos Island, and was never recorded from Riu Kiu and Formosa.

Soleidae

Solea heterorhina BLEEKER Sazanami-shita (new Japanese name) Native name: Oyanerami (Takarajima)

D. ca 95; A. ca 86; V. 4; L. l. ca 120. Head 5.7–6 in length without caudal; depth 2.7–3; eye 4–4.5 in head. Body elongate; eyes on right side; caudal free from dorsal and anal; pectorals present on both sides; upper ray of right pectoral slightly longer than snout and upper eye; left pectoral small, its rays rudimentary. Nostrils close together, covered by a cutaneous flap, which is elongated and longer than eye on colored side. Color yellowish, with pairs of dark transverse wavy lines. Dorsal

and anal have a submarginal black band posteriorly; caudal margined with black, leaving very narrow yellowish edge.

One specimen, 135 mm long, from Takarajima. In shallow water the fish burrows in sand during the daytime.

The species ranges in the seas from Philippines to India (Andaman Islands), Australia and Samoa. It was never known from Riu Kiu and Formosa.

Eleotridae

Eviota abax epiphanes JENKINS Midori-haze Native name: Nichobe (Takarajima)

Color greenish yellow; 6 transverse dark patches on body, the last of which is most distinct.

Several specimens, 30–35 mm long, from both islands.

This species is distributed in the waters from Prov. Tosa to Australia, Polynesia and Hawaii.

Gobiidae

Callogobius hasselti (BLEEKER) Okinawa-haze

Many dermal ridges on top and sides of head and on lower jaw. Scales in lateral series about 50. Color brownish, with a faintly outlined dark saddle over back below middle of spinous dorsal.

One specimen, 63 mm long, from Takarajima.

Distributed in the regions from Riu Kiu to Australia.

Gobius neophytus GÜNTHER Sankaku-haze

Color translucent, with spots of dark orange, some of which are jet black, one at caudal peduncle blackest.

Two specimens, 56 mm in length, from Takarajima.

The species is known in the regions from Riu Kiu to Philippines and Polynesia.

G. ornatus ornatus RÜPPELL Kazari-haze

Upper pectoral rays free from connecting membrane. Scales in lateral series about 28. Color pale brown, with many longitudinal rows of brown spots and pearl-white spots or dots; on lower half of body two rows of large blackish spots, the lower ones rounded, those of upper row elongated or rectangular.

One specimen, 74 mm long, from Takarajima; another 51 mm long, from Nakano-shima.

Widely distributed in the waters from Tanegashima to Red Sea, Australia and Polynesia.

G. fuscus RÜPPELL Kumo-haze

This species is one of the most abundant in the shallow tide pool area of both islands. Many specimens, 35–95 mm long, were secured from both islands.

It occurs in almost all tropical and subtropical seas.

G. semidoliatus CUVIER & VALENCIENNES Irezumi-haze

Color brown anteriorly, olive-yellow behind; anterior parts to vent sharply marked by blunt gray crossbars, each darker edged.

One specimen, 42 mm long, from Takarajima.

The species is widely distributed in the seas from Tanegashima to Red Sea and Polynesia.

G. eugenius (JORDAN & EVERMANN) Benkei-haze

Ventral sucker bilobed posteriorly, without anterior fraenum. Color gray, each scale with a dark edge; head and body with 12 light, vertical bands.

Four specimens, 40–58 mm long, from Takarajima.

The species ranges from Hachijōjima and Tanegashima to the East Indies.

Periophthalmus cantonensis (OSBECK) Tobi-haze Native name: Kikunomi (Takarajima)

None were found, deposite repeated research where the fishes were supposed to occur. It is said to occur at Suwanosejima.

The species is known in the regions from the Tōhoku district of Japan and Korea to Africa, Australia and Polynesia.

Pteropsaridae

Parapercis tetracantha (LACÉPÈDE) Mon-toragisu (new Japanese name) Native name: Bōne or Bōni (Takarajima)

D. IV, 21; A. 17; L. l. ca 65. Color brownish, lighter below; 10 dark brown crossbars on sides and belly, the first through pectoral base, the second below origin of dorsal, the last through caudal peduncle to base of caudal. Caudal light, with several transverse rows of black spots.

One specimen, 80 mm long, from Takarajima.

The species is distributed in the waters from Riu Kiu to Bengal Bay, Micronesia and Polynesia.

Callionymidae

Synchiropus ocellatus (PALLAS) (Fig. 15) Kōwan-teguri

In male, all dorsal spines very elongated, with 4 ocelli and 5 oblique irregular blackish bands. In female, dorsal spines not elongated and without ocelli or bands. Anal much paler than in male and with 4 oblique blackish bands. *S. ijimae* JORDAN & THOMPSON (1914) from Misaki and *S. shoe* OKADA & IKEDA (1937) from Okinawa

Fig. 15. *Synchiropus ocellatus* (PALLAS). (male)

seem to be color variants of this species.

Two male, about 100 mm long, and one female, 75 mm long, from Takarajima.

Widely distributed in the seas from Misaki, Kanagawa Prefecture to Africa, Australia and Samoa.

Gobiesocidae

Aspasma misakia TANAKA Misaki-uba-uo

My specimen well agrees with Dr. TANAKA's description and figure in the "Fig. Descr. Fish. Jap., vol. 4, 1911, p. 58".

A single specimen, 20 mm long, from Nakanoshima.

It is known in the regions from Chiba Prefecture to Okinawa.

Blenniidae

The fishes of the family form one of the most abundant fishes on the reefs in this district. All blennies are called Nichobe or Nichirobe (Takarajima) and Mitchabe (Nakanoshima) by the natives. They pay no attention to them, none are used for food. Some of these blennies agilely climb over even the vertical rock face and were reluctant to jump back into the water.

Enneapterygius etheostoma (JORDAN & SNYDER) (Fig. 16) Tsubame

Most abundant fish in tide pools of both islands, especially in Nakanoshima. Numerous specimens, 30–60 mm long, were secured. The fish seems to undergo considerable changes with growth.

Known in the regions from Chiba Prefecture to Okinawa.

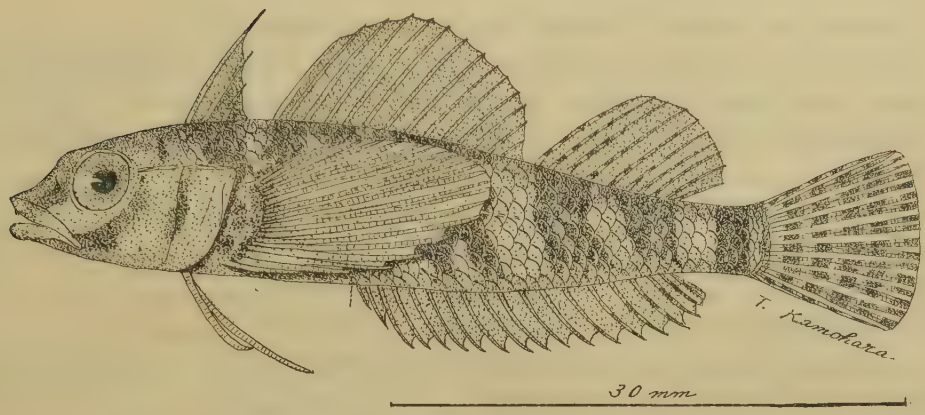

Fig. 16. *Enneapterygius etheostoma* (JORDAN & SNYDER). (male)

Tripterygion articeps (JENKINS) Irezumi-gimpo (new Japanese name)

Color yellowish brown, side of body with 6 pairs of dark brown irregularly vertical bars more or less confluent. Head marked with bluish brown.

Four specimens, about 35 mm long, from Takarajima. The natives have no name for this fish, being too small to be any consequence to them.

Hitherto known only from Hawaii.

Istiblennius enosimae (JORDAN & SNYDER) Kaeru-uo

Common in both islands. Many specimens, 60–130 mm long, were secured.

Occurs in the seas from the middle part of Japan to Riu Kiu.

I. edentulus (BLOCH & SCHNEIDER) Nise-kaeru-uo (new Japanese name)

Color dull brown, side of body finely dotted brown posteriorly; one oblique brown bar behind eye.

Rather common at Nakanoshima. Length 60–135 mm.

Widely distributed in the seas from China to Red Sea, Madagascar, Australia, Melanesia, Polynesia and Hawaii. The species was never known from Riu Kiu and Formosa.

I. tanegashimae (JORDAN & STARKS) Tane-gimpo

Rather common in both islands. Many specimens, 40–100 mm long, were collected.

The species ranges from Suruga Bay to Miyakojima, near Formosa.

I. lineatus (CUVIER & VALENCIENNES) Sen-kaeru-uo

Color dusky generally, side of body with several dark narrow longitudinal lines.

Five specimens, 93–140 mm long, from Nakanoshima.

The species is known in the regions from Okinawa to Red Sea, Australia, Melanesia, Micronesia, Polynesia and Hawaii. Recently Dr. TOMIYAMA has recorded it from Tanegashima (Annot. Zool. Jap., vol. 25, 1952, p. 302).

I. cyanostigma BLEEKER Aoten-gimpo (new Japanese anme)

Crest present on head; no nuchal cirri; forehead definitely projecting beyond vertical from upper lip. Color greenish brown, with 5 brown narrow longitudinal lines and with blue dots on sides of body; posterior part of body and caudal dotted with black.

Two specimens, 85 and 97 mm long respectively, from Takarajima.

The species has hitherto been recorded from the regions from Philippines to India and Samoa. New to Japan.

I. periophthalmus (CUVIER & VALENCIENNES) Ami-gimpo

Color yellowish brown; anal light brownish, becoming blackish marginally; upper half of caudal whitish, lower half dusky.

Three specimens, 103–122 mm long, from Takarajima.

Distributed in the waters from Okinawa to India, Micronesia, Melanesia, Polynesia and Hawaii.

I. sp.

No crest on head; anterior profile of snout nearly vertical. Color yellowish gray, with more or less bluish wash; head without markings; vertical fins with brownish spots; pectorals white with 3 rows of minute dots.

Two specimens, 64 and 95 mm long respectively, from Takarajima.

It seems to me to be identified with *I. bilitonensis* BLEEKER.

Fig. 17. *Istiblennius sp.* ??

I. sp. ?? (Fig. 17)

D. XI, 14; A. 19; P. 13; V. I, 2. Head 3.9 in length without caudal; depth 5.4; eye 4 in head; snout 14.7; interorbital 6.3; depth of caudal peduncle 3. No crest on head; nasal cirrus simple, equal in length to half eye-diameter. No supraorbital nor nuchal cirri. Anterior profile of snout nearly vertical; eyes large, located in upper, anterior part of head. Mouth inferior, horizontal, lower jaw somewhat shorter than upper; each lip smooth, not crenulate; teeth in a single row in each jaw, minute,

slender, close-set, loosely embedded in the fleshy gums; no canines.

Dorsals separated by a deep notch; highest spine 2.1 in head, rays longer than the spines, 1.6 in head; membrane of anal incised between the rays, leaving their tips free, the longest 2 in head; neither dorsal nor anal attached to caudal by membrane; pectoral acutely rounded, slightly shorter than head, the membrane incised between lower 5 rays which are somewhat enlarged; ventrals 2 in head; caudal subtruncate, equal in length to pectoral. Head and body naked; lateral line extending above pectoral and ending shortly beyond tip of depressed fin.

Color reddish brown; upper side of body with a double row of rounded blackish blotches, as large as eye; below last rays of dorsal a large saddle-like black blotch. Ventral blackish; anal dusky; caudal with an oblique blackish band from base of upper rays; base of caudal blackish; along lower edge of caudal a blackish band submarginally.

One specimen, 53 mm long, from Takarajima. Probably new to science.

Rhadoblennius ellipes (JORDAN & STARKS) Rōsoku-gimpo

Several specimens, 50–66 mm long, from both islands.

The species is known in the regions from Prov. Tosa to Okinawa.

Entomacrodus striatus (QUOY & GAIMARD) Suji-gimpo (new Japanese name)

No crest on head. Color reddish yellow, marbled with purple and dotted with violet; a blackish transverse bar behind eye; fins yellowish.

Several specimens, 55–95 mm long, from Nakanoshima.

This species is widely distributed in the seas from Japan (locality not clear) to Mauritius, Micronesia, Melanesia and Polynesia.

E. sp.?

No crest on head; front profile of snout nearly vertical. Color dusky brown, side of body with several dark longitudinal lines and irregularly formed large dark blotches. Dorsal with oblique blackish streaks; anal with a dark longitudinal band basally; caudal with 3 dark crossbands.

Three specimens, 85–125 mm long, from Nakanoshima.

It seems to me to be identified with *E. decussatus* (BLEEKER).

E. sp.?

No trace of crest on head. Color reddish yellow; side of body with about 10 saddle-like faint reddish brown blotches; a sharply defined violet patch, slightly larger than eye, above pectoral base. Caudal crossed by 4 dark bands. In the male, anal dusky with tips of rays sharply black; in the female, anal lighter.

Five specimens, 54–67 mm long, from Nakanoshima.

It seems to be referable to *E. caudofasciatus* (REGAN).

REPORT ON THE MOLLUSCA CHIEFLY COLLECTED BY THE S. S. SÔYÔ-MARU OF THE IMPERIAL FISHERIES EXPERIMENTAL STATION ON THE CONTINENTAL SHELF BORDERING JAPAN DURING THE YEARS 1922-1930

PART 1. CEPHALASPIDEA*

TADASHIGE HABE
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With Plate XXXVIII

Numerous specimens of molluscan shells were collected from the surrounding seas of Japan by the S. S. Sôyô-maru of the Imperial Fisheries Experimental Station (now the Tokai Regional Fisheries Research Laboratory) and other ships during the years 1922–1930, but they have never been reported completely till now. The materials are deposited in various museums, such as the Saitô Hô-ôn Kai Museum at Sendai, the Geological Institute of Tokyo University and the Zoological Institute of Kyoto University.

As far as I am aware, the 22 species have hitherto been described as new species in various Japanese journals, based on this collection. They are:

Nucula cyrenoides KURODA, 1929 (Nuculidae)[1]; *Ancistrolepis fujitai* KURODA, 1931 (Buccinidae)[2]; *Dentalium marukawai* OTUKA, 1933 (Dentaliidae)[3]; *Calliostoma (Tristichotrochus) soyoae* IKEBE, 1942 (Trochidae)[4]; *Myadora soyoae* HABE, 1950 (Myochamidae)[5]; *Myadora japonica* HABE, 1950 (Myochamidae)[6]; *Schizotrochus soyoae* HABE, 1951 (Scissurellidae)[7]; *Fissurisepta soyoae* HABE, 1951 (Fissurellidae)[8]; *Turritella andenensis tsushimaensis* KOTAKA, 1951 (Turritellidae)[9]; *Laevicirce soyoae* HABE, 1951 (Veneridae)[10]; *Poromya castanea* HABE, 1952 (Poromyidae)[11]; *Dermatomya tenuiconcha soyoae* HABE, 1952 (Poromyidae)[12]; *Cetoconcha japonica* HABE, 1952

1) Venus, **1**(3), App. p. 7; 2) *l. c.*, **2**(5), p. 223; 3) *l. c.*, **4**(3), p. 159; 4) Jap. Jour. Geol. Geogr., **18**(4), p. 260; 5) Illust. Cat. Jap. Shells, **4**, p. 25; 6) *l. c.*, **4**, p. 27; 7) *l. c.*, **11**, p. 66; 8) *l. c.*, **18**, p. 116; 9) Short Paper IGPS, **3**, p. 81; 10) Genera Jap. Shells, **2**, p. 160; 11) Illust. Cat. Jap. Shells, **21**, p. 156; 12) *l. c.*, **21**, p. 158.

* Contributions from the Seto Marine Biological Laboratory, No. 223.

(Poromyidae)[13]; *Divalucina soyoae* HABE, 1952 (Lucinidae)[14]; *Eoscaphander fragilis* HABE, 1952 (Triclidae)[15]; *Tindaria soyoae* HABE, 1953 (Malletiidae)[16]; *Limopsis soyoae* HABE, 1953 (Limopsidae)[17]; *Notomyrtea soyoae* HABE, 1953 (Lucinidae)[18]; *Trophonopsis delicatus* KURODA, 1953 (Muricidae)[19]; *Trophonopsis polycyma* KURODA, 1953 (Muricidae)[20]; *Trophonopsis crystallinus* KURODA, 1953 (Muricidae)[21]; *Limopsis crassula* HABE, 1953 (Limopsidae)[22].

In this first report the Cephalaspid group of Opisthobranchiate molluscs is dealt with by the writer. Thirty seven species belonging to this group were obtained from 63 stations in all (see Appendix). Of these four species and one subspecies are new to science.

My hearty thanks are due to Dr. Denzaburo MIYADI and Dr. Tokubei KURODA for their kind direction and encouragement in the course of this study.

Class **GASTROPODA**
Subclass OPISTHOBRANCHIA
Order TECTIBRANCHIA
Superfamily Cephalaspidea
Family Pupidae
Genus *Pupa* RÖDING 1798

1. *Pupa strigosa* (GOULD)

(Pl. XXXVIII, Fig. 25)

1859 *Buccinulus strigosus* GOULD, Proc. Boston Soc. Nat. Hist., **7**, p. 141.
1871 *Tornatella strigosa* LISCHKE, Jap. Meer. Conchyl., **2**, p. 104, pl. 5, figs. 12, 13.
1882 *Buccinulus fraterculus* DUNKER, Index Moll. Mar. Japan, p. 161, pl. 13 figs. 21–23.

Locality: St. 433, Off Goto Islands, Kyushu, 168 m.

Distribution: Formosa: Ryukyu and Amami groups; Kyushu, Shikoku and Honshu.

Remarks: This is one of the commonest species in the shallow water.

Genus *Acteon* MONTFORT 1810

2. *Acteon siebaldii* (REEVE)

(Pl. XXXVIII, Fig. 26)

1842 *Tornatella siebaldii* REEVE, Proc. Zool. Soc. London, p. 61.
1865 *Tornatella siebaldii* REEVE, Conch. Icon., sp. 11.

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13) *l. c.*, **21**. p. 159; 14) *l. c.*, **21**, p. 160; 15) Venus, **17**(2), p. 76; 16) *l. c.*, **17**(3), p. 136; 17) *l. c.*, **17**(3), p. 137; 18) *l. c.*, **17**(3), p. 138; 19) *l. c.*, **17**(4), p. 186; 20) *l. c.*, **17**(4), p. 187; 21) *l. c.*, **17**(4), p. 188; 22) Illust. Cat. Jap. Shells, **25**, p. 202.

Localities: St. 252, Sagami Bay, Honshu, 289 m; St. 259, Suruga Bay, Honshu, 188 m; St. 286, Enshu-nada, Honshu, 123 m.

Distribution: Honshu.

3. *Acteon kawamurai* HABE

(Pl. XXXVIII, Fig. 5)

1952 *Acteon kawamurai* HABE, Jap. Jour. Malac. (Venus), **17**, pp. 70, 76, textfig. 1

Locality: St. 431, SW of Nagasaki, Kyushu, 152 m.

Distribution: Honshu (Sagami Bay) and Kyushu.

Family Ringiculidae

Genus *Ringicula* DESHAYES 1838

4. *Ringicula niinoi* NOMURA

1939 *Ringicula niinoi* NOMURA, Jap. Jour. Geol. Geogr., **16**, p. 14, pl. 2, figs. 15a, b.

Localities: St. 252, Sagami Bay, 289 m; St. 255, Off Izu Peninsula, 263 m: St. 417, Off Satsuma Peninsula, Kyushu, 192 m; St. 484, Off Aburadani Bay, Yamaguchi Pref., Honshu, 93 m: St. 488, NW of Shimane Peninsula, Honshu, 406 m; St. 503, Off Oki Islands in the Japan Sea, 146 m; St. 520, Off Shimane Peninsula, Honshu, 75 m.

Distribution: Kyushu; Shikoku and Honshu.

Subgenus *Ringiculina* MONTEROSATO 1884

5. *Ringicula* (*Ringiculina*) *pilula* HABE

(Pl. XXXVIII, Fig. 3)

1950 *Ringicula* (*Ringiculina*) *pilula* HABE, Illust. Cat. Jap. Shells, **2**, p. 10, pl. 2, fig. 11.

Localities: St. 203, Kumano-nada, Honshu, 249 m; St. 205, Kumano-nada, 224 m; St. 255, Off Shimoda, Izu Peninsula, 263 m; St. 331, Off Cape Ashizuri, Shikoku, 344 m.

Distribution: Shikoku and Honshu (Pacific side).

6. *Ringicula* (*Ringiculina*) *teramachii* HABE

1950 *Ringicula* (*Ringiculina*) *teramachii* HABE, Illust. Cat. Jap. Shells, **2**, p. 9, pl. 2, fig. 6.

Locality: St. 221, Tosa Bay, Shikoku, 209 m.

Distribution: Shikoku.

7. *Ringicula* (*Ringiculina*) *yokoyamai* TAKEYAMA

1935 *Ringicula* (*Ringiculella*) *yokoyamai* TAKEYAMA, Venus, **5**, p. 74, pl. 5, figs. 19, 20 and

pl. 6, figs. 21–25.

Localities: St. 432, West of Nagasaki, Kyushu, 148 m; St. 433, West of Nagasaki, 168 m; St. 459, West of Tsushima, between Kyushu and Korea, 115 m.

Remarks: Only dead specimens have been collected at the three stations, but they do not seem to be recent form but a fossil one. This species is very common in the deposits of Pliocene and Pleistocene of Japan.

Family Hydatinidae

Genus *Bullina* FERUSSAC 1822

8. *Bullina nobilis* HABE

(Pl. XXXVIII, Fig. 32)

1950 *Bullina nobilis* HABE, Illust. Cat. Jap. Shells, **3**, p. 19, pl. 3, fig. 11.

Locality: St 247, Off Atami, Sagami Bay, 159–128 m.

Distribution: Kyushu; Shikoku and Honshu.

Remarks: The specimen from St. 247 was erroneously recorded as *Bullina virgo* HABE by the writer (1950).

Family Atyidae

Genus *Limulatys* IREDALE 1936

9. *Limulatys angustatus* (GOULD)

(Pl. XXXVIII, Fig. 22)

1859 *Haminea angustata* GOULD, Proc. Boston Soc. Nat. Hist., **7**, p. 139.
1952 *Limulatys angustatus* HABE, Illust. Cat. Jap. Shells, **20**, p. 140, pl. 21, fig. 21.

Locality: St. 4, Off Katsuura, Bôsô Peninsula, 287 m.

Distribution: Kyushu and Honshu.

Genus *Liloa* PILSBRY 1921

10. *Liloa porcellana* (GOULD)

1859 *Atys porcellana* GOULD, Proc. Boston Soc. Nat. Hist., **7**, p. 138.
1882 *Cylichna semisulcata* DUNKER, Index Moll. Mar. Japon., p. 163, pl. 13, figs. 7–9.
1928 *Cylichna incisula* YOKOYAMA, Imp. Geol. Surv. Japan, Rep. No. 101, p. 122, pl. 19, fig. 1.

Locality: St. 4, Off Katsuura, Bôsô Peninsula, 287 m.

Distribution: Kyushu; Shikoku and Honshu.

Family Retusidae

Genus *Retusa* Brown 1827

Subgenus *Coelophysis* Fischer 1883

11. *Retusa* (*Coelophysis*) *minima* Yamakawa

(Pl. XXXVIII, Fig. 19)

1911 *Retusa minima* Yamakawa, Jour. Geol. Soc. Tokyo, **18**, p. 47, pl. 11, figs. 21–24.

Localities: St. 4, Off Katsuura, Bôsô Peninsula, 287 m; St. 326, Off Cape Ashizuri, Shikoku, 393 m; St. 520, Off Shimane Peninsula, Honshu, 75 m.

Distribution: North China; Kyushu; Shikoku and Honshu.

12. *Retusa* (*Coelophysis*) *succincta* (A. Adams)

1862 *Tornatina succincta* A. Adams, Ann. Mag. Nat. Hist., (3) **9**(50), p. 154.
1927 *Retusa cucurbitina* Yokoyama, Jour. Fac. Sci. Imp. Univ. Tokyo, (2) **1** (10), p. 449, pl. 51, fig. 4.
1939 *Retusa percucurbitina* Nomura, Jap. Jour. Geol. Geogr., **16**(1–2), p. 25, pl. 2, figs. 2a, b.

Locality: St. 477, Off Fusan, Korea, 99 m.

Distribution: Kyushu; Shikoku and Honshu.

Genus *Pyrunculus* Pilsbry 1894

13. *Pyrunculus obesus* Habe

(Pl. XXXVIII, Fig. 6)

1950 *Pyrunculus obesus* Habe, Illust. Cat. Jap. Shells, **2**, p. 13. pl. 2, fig. 12.

Localities: St. 352, Off Tanabe, Wakayama Pref., Honshu, 154 m; St. 432, West of Nagasaki, Kyushu, 148 m; St. 433, South of Goto Islands, Kyushu, 168 m.

Distribution: Kyushu; Shikoku and Honshu.

Remarks: This species stands close to *Pyrunculus pyriformis* (A. Adams) from China, but does not constrict so strongly below the vertex and lacks the transverse striations at the upper and lower parts of the shell.

14. *Pyrunculus phialus* (A. Adams)

(Pl. XXXVIII, Fig. 7)

1862 *Atys* (*Sao*) *phiala* A. Adams, Ann. Mag. Nat. Hist., (3) **9** (50), p. 160.
1911 *Cylichna sibaensis* Yamakawa, Jour. Geol. Soc. Tokyo, **18**, p. 39, pl. 11, figs. 25–29.

Localities: St. 4, Off Katsuura, Bôsô Peninsula, 287 m; St. 212, Off Tanabe Bay, Wakayama Pref., Honshu, 181 m; St. 363, Kumano-nada, 439 m; St. 417, Off Makurazaki, Kagoshima Pref., Kyushu, 192 m; St. 471, Off Aburadani Bay, Yamaguchi Pref.,

Honshu, 90 m; St. 483, North of Aburadani Bay, 130 m; St. 484, Off Aburadani Bay, 93 m; St. 488, North of Misima, Yamaguchi Pref., Honshu, 406 m; St. 503, Off Oki Islands in the Japan Sea, 146 m; St. 520, Off Shimane Peninsula, Honshu, 75 m.

Distribution: China; Kyushu; Shikoku and Honshu.

Genus *Volvulella* NEWTON 1891

15. *Volvulella tokunagai* MAKIYAMA

1927 *Volvulella acuminata tokunagai* MAKIYAMA, Mem. Coll. Sci. Kyoto Imp. Univ., (B) **3**, p. 141.
1946 *Rhizorus tokunagai* HABE, Jap. Jour. Malac., **14** (5–8), p. 185, fig. 5.

Locality: St. 395, Off Tanabe Bay, Wakayama Pref., Honshu, 46 m.

Distribution: Honshu.

16. *Volvulella ovulina* (A. ADAMS)

(Pl. XXXVIII, Fig. 30)

1862 *Volvula ovulina* A. ADAMS, Ann. Mag. Nat. Hist., (3) **9** (50), p. 156.
1875 *Volvula angustata* SMITH, *l. c.*, (4) **16**, p. 144 (non A. ADAMS, 1850).
1922 *Volvula acutaeformis* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44** (1), p. 26, pl. 1, fig. 9.

Localities: St. 211, Off Tanabe Bay, Honshu, 190 m; St. 212, Off Tanabe Bay, 181 m; St. 259, West of Izu Peninsula, 188 m; St. 326, Off Okinoshima, Shikoku, 390 m; St. 371, Off Atsumi Peninsula, Honshu, 84 m; St. 468, East of Tsushima between Kyushu and Korea, 112 m; St. 471, West of Aburadani Bay, Yamaguchi Pref., Honshu, 90 m; St. 480, East of Fusan, Korea, 280 m; St. 483, North of Aburadani Bay, 130 m; St. 484, Off Aburadani Bay, 93 m; St. 486, North of Mishima in Japan Sea, 139 m; St. 488, North of Mishima, 406 m; St. 491, North of Mishima, 112 m; St. 493, Off Hamada, Shimane Pref, Honshu, 124 m.

Distribution: According to the sketch of the type specimen of this species made by Dr. Jiro MAKIYAMA, the shell deposited in the British Museum (Natural History) shows that *Volvula ovulina* A. ADAMS is identical with *V. acutaeformis* YOKOYAMA.

17. *Volvulella radiola* (A. ADAMS)

1862 *Volvula radiola* A. ADAMS, Ann. Mag. Nat. Hist., (3) **9**, p. 155.
1920 *Volvula acuminata* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39** (6), p. 26, pl. 1, fig. 2.
1939 *Rhizorus aomoriensis* NOMURA, Jap. Jour. Geol. Geogr., **16** (1-2), p. 26, pl. 1, figs. 9a, b.

Locality: St. 493, Off Hamada, Shimane Pref., Honshu, 124 m.

Distribution: Honshu.

18. *Volvulella kinokuniana* (HABE)

1946 *Rhizorus kinokunianus* HABE, Jap. Jour. Malac., **14** (5-8), p. 186.

Locality: St. 503, Off Oki Islands in Japan Sea, 146 m.
Distribution: Honshu and Shikoku.

Family Triclidae

Genus *Eoscaphander* HABE 1952

19. *Eoscaphander fragilis* HABE

(Pl. XXXVIII, Fig. 28)

1952 *Eoscaphander fragilis* HABE, Jap. Jour. Malac. (Venus), **17**, pp. 75, 76, textfigs. 7, 8.

Locality: St. 15, Off Inubôzaki, Honshu, 216 m.
Distribution: The Pacific coast of northern Honshu.

Genus *Bucconia* DALL 1890

20. *Bucconia teramachii* n. sp.

(Pl. XXXVIII, Figs. 1, 2)

Description: Shell rather small for the genus, thin, dull white, swollen, broadly ovate, narrowed on both ends: spire concealed; vertex concave, but not perforated; body whorl sculptured with many spiral grooves which are very distinctly punctulate; aperture dilate, narrowed posteriorly; upper margin extending beyond the apex in the form of an obtuse process; outer margin regularly arcuate; basal margin rounded; columellar margin somewhat thickened and arcuate; umbilical slit present.

Length 9.0 mm, breadth 5.9 mm (figured type specimen collected from Tosa Bay, Shikoku by Mr. Akibumi TERAMACHI and deposited in the Zoological Institute, Kyoto University).

Locality: St. 255, East of Izu Peninsula, 263 m.
Distribution: Shikoku and Honshu.

Remarks: The nearest ally of this new species is *Bucconia attenuata* (SCHEPMAN) from East Indies which has a larger and more attenuated shell. The aperture of the latter is more dilate anteriorly.

21. *Bucconia japonica* (A. ADAMS)

(Pl. XXXVIII, Figs. 20, 21)

1862 *Scaphander japonica* A. ADAMS, Ann. Mag. Nat. Hist., (3) **9**, p. 156.

Localities: St. 300, Off Toizaki, Kyushu, 110 m; St. 417, Off Makurazaki, Kyushu,

110 m; St. 488, North of Mishima in the Japan Sea, 406 m.

Distribution: Kyushu; Shikoku and Honshu.

Remarks: So far as we concerned, this is the first time to figure this species.

22. *Bucconia cumingii* (A. ADAMS)

(Pl. XXXVIII, Fig. 31)

1862 *Scaphander cumingii* A. ADAMS, Ann. Mag. Nat. Hist., (3) **9**, p. 156.

Localities: St. 259, West of Izu Peninsula, 188 m; St. 325, Off Sukumo, Shikoku, 210 m.

Distribution: Shikoku and Honshu.

23. *Bucconia cumingii ventricosa* n. subsp.

(Pl. XXXVIII, Figs. 17, 18)

Description: Shell similar to the preceding species in the sculpture, but is differing in proportionally more ventricose shape and is not distinctly constricted posteriorly.

Length 7.5 mm, breadth 4.0 mm (figured type specimen collected from the Tosa Bay by Mr. Akibumi TERAMACHI and deposited in his collection).

Localities: St. 2, Off Nojimazaki, Bôsô Peninsula, 176 m; St. 259, West of Izu Peninsula, 188 m.

Distribution: Shikoku and Honshu.

Genus *Abderospira* DALL 1895

24. *Abderospira punctulata* (A. ADAMS)

(Pl. XXXVIII, Fig. 24)

1862 *Roxania punctulata* A. ADAMS, Ann. Mag. Nat. Hist., (3) **9**, p. 158.
1922 *Bulla multiarata* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44**, p. 29, pl. 1, fig. 14.

Locality: St. 221, Tosa Bay, 209 m.

Distribution: Shikoku and Honshu.

Genus *Adamnestia* IREDALE 1936

25. *Adamnestia japonica* (A. ADAMS)

(Pl. XXXVIII, Fig. 23)

1862 *Cylichna japonica* A. ADAMS, Ann. Mag. Nat. Hist., (3) **9**, p. 150.
1920 *Cylichna musashiensis* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39**. p. 27, pl. 1, fig, 4 (non TOKUNAGA, 1906).

Localities: St. 251, Off Itô, Sagami Bay, 165 m; St. 433, South of Goto Islands 168 m; St. 439, Off Danjo Islands, Kyushu, 155 m; St. 466, Between Iki and Tsushima, 110 m; St. 468, East of Tsushima, 112 m; St. 484, Off Aburadani Bay Yamaguchi Pref., Honshu, 93 m; St. 488, North of Mishima in Japan Sea, 406 m; St. 493, Off Hamada, Shimane Pref., Honshu, 124 m; St. 494, Off Hamada, 110 m; St. 495, West of Shimane Peninsula, 146 m.

Distribution: Kyushu; Shikoku and Honshu.

26. *Adamnestia tosaensis* n. sp.

(Pl. XXXVIII, Figs. 11, 12)

Remarks: This new species closely resembles *A. japonica*, but it is distinguished by its somewhat smaller and regularly cylindrical shell which is provided with a distinct umbilicus.

Length 9.3 mm, breadth 3.6 mm (figured type specimen collected from Tosa Bay, Shikoku by Mr. Akibumi TERAMACHI and deposited in his collection).

Localities: St. 211 and 212, Off Tanabe Bay, Wakayama Pref., Honshu, 190 m and 181 m; St. 220 and 221, Tosa Bay, 234 m and 209 m; St. 259, West of Izu Peninsula, 188 m; St. 279, Senoumi, Suruga Bay, 155 m; St. 304, Off Toizaki, Kyushu, 241 m; St. 311, Off Miyazaki, Hyuga-nada, 165 m; St. 325, Off Sukumo, Shikoku, 210 m; St. 331, Off Ashizurizaki, Shikoku, 344 m; St. 352, West of Goto Islands, 154 m; St. 431, South-west of Nagasaki, Kyushu, 152 m; St. 439, Off Danjo Islands, Kyushu, 155 m; St. 444, South of Goto Island, 194 m; St. 452, West of Goto Islands, 154 m; St. 470, Off Hakata Bay, Kyushu, 73 m; St. 471, West of Aburadani Bay, Yamaguchi Pref., Honshu, 90 m; St. 477, Between Tsushima and Fusan, Korea, 99 m; St. 491, North of Mishima in Japan Sea, 112 m.

Distribution: Kyushu; Shikoku and Honshu.

27. *Adamnestia teramachii* n. sp.

(Pl. XXXVIII, Figs. 9, 10)

Description: Shell cylindrical, thin, covered with a yellowish periostracum; spire convolute; vertex deeply perforated; surface polished, weakly marked with numerous minute and densely set spiral striations throughout; aperture narrow, slightly widened below; upper margin somewhat produced posteriorly beyond the apex; outer margin straight; basal margin rounded; columellar margin oblique, thickened, forming a weak fold; umbilicus open, partly covered by the dilation of the columellar margin.

Length 4.7 mm, breadth 2.3 mm (figured type specimen collected from the Tosa Bay, Shikoku by Mr. Akibumi TERAMACHI and deposited in his collection).

Locality: St. 259, West of Izu Peninsula, 188 m.

Distribution: Shikoku and Honshu.

Remarks: This is the smallest species of this genus known from Japan and characterized by its sculpture consisting of numerous minute striations all over the surface which are not strengthened even at the terminal areas.

Genus *Eocylichna* KURODA et HABE 1952

28. *Eocylichna musashiensis* (TOKUNAGA)

(Pl. XXXVIII, Figs. 13, 14)

1906 *Cylichna musashiensis* TOKUNAGA, Jour. Coll. Imp. Univ. Tokyo, **21**, p. 32, pl. 2, fig. 12.

Localities: St. 490, North of Mishima in Japan Sea, 155 m; St. 493 and 494, Off Hamada, Shimane Pref., Honshu, 124 m and 110 m; St. 549, Urashimasyo, Wakasa Bay, 115 m.

Distribution: Kyushu; Shikoku and Honshu.

29. *Eocylichna soyoae* n. sp.

(Pl. XXXVIII, Figs. 15, 16)

Description: Shell dull white, rather solid, cylindric ovate, slightly attenuated above, spire convolute; vertex broadly truncated and deeply excavated forming an angle at the border; surface sculptured with the numerous minute spiral striations throughout; aperture narrow, widened below; upper margin produced upwardly forming an angle at the top; outer margin rather straight, basal margin rounded; columellar margin short and thickened, provided by an obtuse fold at the middle; umbilical chink narrow.

Length 6.2 mm, breadth 3.0 mm (figured type specimen collected from Tosa Bay by Mr. Akibumi TERAMACHI and deposited in his collection).

Localities: St. 4, Off Katsuura, Bôsô Peninsula, 287 m; St. 12, Off Inubôzaki, 325 m; St. 199, Off Nakirizaki, Shima Peninsula, Honshu, 207 m; St. 205, Off Kinomoto, Kumano-nada, Honshu, 224 m; St. 207, Off Shionomisaki, Kii Peninsula, 229 m; St. 212, Off Tanabe, Wakayama Pref., Honshu, 181 m; St. 221 and St. 240, Tosa Bay, 209 m and 192 m; St. 255, East of Izu Peninsula, 263 m; St. 259, West of Izu Peninsula, 188 m; St. 295, North of Tanegashima, South of Kyushu, 154 m; St. 300, Off Toizaki, Kyushu, 110 m; St. 326, Off Okinoshima, Shikoku, 393 m; St. 347, Off Kannoura, Shikoku, 126 m; St. 363, Off Owase, Kumano-nada, 439 m; St. 417, Off

Makurazaki, Kyushu, 192 m; St. 432, West of Nagasaki, Kyushu, 148 m; St. 433, South of Goto Islands, Kyushu, 168 m; St. 451 and 452, West of Goto Islands, 187 m and 154 m; St. 468, East of Tsushima, 112 m; St. 470, Off Hakata Bay, Kyushu, 73 m; St. 477, Off Fusan, Korea, 99 m; St. 488, Mishima in Japan Sea, 406 m; St. 493, Off Hamada, Shimane Pref., Honshu, 124 m; St. 495, West of Shimane Peninsula, 146 m; St. 504, Off Oki Islands in Japan Sea, 106 m; St. 546, Off Tsuruga, Wakasa Bay, 101 m.

Distribution: Kyushu; Shikoku and Honshu.

Genus *Cylichna* LOVÉN 1847

30. *Cylichna consobrina* (GOULD)

(Pl. XXXVIII, Fig. 29)

1859 *Cylichna consobrina* GOULD, Proc. Boston Soc. Nat. Hist., **7**, p. 141.
1875 *Haminea grisea* SMITH, Ann. Mag. Nat. Hist., (4) **16**, p. 118.

Locality: St. 490, Off Hamada, Shimane Pref., Honshu, 155 m.

Distribution: Hokkaido and Honshu.

31. *Cylichna nipponensis* NOMURA et HATAI

1940 *Cylichna nipponensis* NOMURA et HATAI, Saitô Hô-on Kai Museum, Res. Bull., **19**, p. 72, pl. 3, figs. 8a, b.

Localities: St. 652, Off Matsumae, Southern Hokkaido, 110 m; St. 658, Off Shiriyazaki, Northernmost of Honshu, 113 m.

Distribution: Northern Honshu and Hokkaido.

Genus *Acteocina* GRAY 1847

Subgenus *Tornatina* A. ADAMS 1850

32. *Acteocina* (*Tornatina*) *exilis* (DUNKER)

1860 *Bulla exilis* DUNKER, Malak. Bl., **6**, p. 222.
1864 *Tornatina exilis* DUNKER, Moll. Jap., p. 25, pl. 2, fig. 14.

Locality: St. 4, Off Katsuura, Bôsô Peninsula, 287 m.

Distribution: Amami group; Kyushu; Shikoku and Honshu.

Subgenus *Trucacteocina* HABE MS.

33. *Acteocina* (*Truncacteocina*) *oyamai* HABE MS.

1954 *Acteocina* (*Truncacteocina*) *oyamai* HABE, Bull. Biogeogr. Soc. Japan. (in press).

Localities: St. 452, West of Goto Islands, Kyushu, 154 m; St. 493, Off Hamada,

Shimane Pref., Honshu, 124 m.

Distribution: Kyushu; Shikoku and Honshu.

Genus *Decolifer* IREDALE 1937

34. *Decolifer longispirata* (YAMAKAWA)

1911 *Tornatina longispirata* YAMAKAWA, Jour. Geol. Soc. Tokyo, **18**, p. 41, pl. 10, figs. 8–10.

Locality: St. 520, Off Shimane Peninsula, Honshu, 75 m.

Distribution: Honshu.

Family Philinidae

Genus *Philine* ASCANIUS 1772

35. *Philine japonica* LISCHKE

(Pl. XXXVIII, Fig. 4)

1874 *Philine japonica* LISCHKE, Malak. Bl., **19**, p. 105.
1874 *Philine japonica* LISCHKE, Jap. Meer. Conchyl., **3**, p. 77, pl. 5, figs. 13, 14.
1874 *Philine striatella* TAPPARONE-CANEFRI, Zool. Viaggio Globo R. Fregata Magenta, Malac., p. 109, pl. 2, fig. 9.
1922 *Philine pygmaea* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44**, p. 28, pl. 1, fig. 13.

Locality: St. 298, Off Shibushi Bay, Kyushu, 117 m.

Distribution: Kyushu; Shikoku and Honshu.

36. *Philine kurodai* HABE

(Pl. XXXVIII, Fig. 27)

1946 *Philine kurodai* HABE, Jap. Jour. Malac., **14**, p. 188, figs. 1, 2.

Localities: St. 12, Off Inubôzaki, Honshu, 325 m; St. 483, North of Aburadani Bay, Yamaguchi Pref., Honshu, 130 m.

Distribution: Shikoku and Honshu.

37. *Philine scalpta* A. ADAMS

(Pl. XXXVIII, Fig. 8)

1862 *Philine scalpta* A. ADAMS, Ann. Mag. Nat. Hist., (3) **9** (50), p. 160.
1945 *Philine miyadii* HABE, Jap. Jour. Malac., **14**, p. 189.

Locality: St. 488, North of Mishima in Japan Sea, 406 m.

Distribution: Kyushu, Shikoku and Honshu.

Appendix

Detailed dredging and hydrographic records relative to the survey of the S. S. Sôyô-maru and other ships were published in the following three reports: Annotation of the Oceanographical Research, Vol. 3, No. 1, pp. 1–13, pls. 1–2 (1925), Ibid., Vol. 3, No. 2, pp. 1–17, pl. 3 (1929) and Semi-annual Report of Oceanographical Investigation, Imp. Fish. Exper. Station, No. 48, pp. 259–277, pl. 4 (1931). The station records at which molluscs dealing with in this paper were collected have been assembled from these sources.

Table 1. List of stations at which Cephalaspid molluscs were chiefly collected by the S. S. Sôyô-maru during the years 1922–1930.

Station No.	Date	Locality		Depth (m)	Bottom Water Temp. (C°)	Bottom character	Species of Cephalaspids
		Lat. N.	Long. E.				
2	1926 June 16	34° 49′ 40″	139° 51′ 40″	176	—	R	*Bucconia cumingii ventricosa* *Eocylichna soyoae*
4	do	34 57 30	140 06 00	287	8.9	S	*Limulatys angustatus* *Liloa porcellana* *Retusa minima* *Pyrunculus phialus* *Acteocina exilis*
12	June 23	35 34 45	141 13 35	325	7.2	m. S	*Eocylichna soyoae* *Philine kurodai*
15	June 24	35 59 00	140 59 25	216	8.2	m. S	*Eoscaphander fragilis*
199	1927 July 11	34 10 30	136 54 30	207	9.7	s. M	*Eocylichna soyoae*
203	July 12	33 59 20	136 21 40	249	11.0	m. S	*Ringicula niinoi* *Ringicula pilula*
205	do	33 47 30	136 09 30	224	11.3	M. S. Sh	*Ringicula pilula* *Eocylichna soyoae*
207	July 13	33 30 40	135 57 15	229	11.7	S	*Eocylichna soyoae*
211	July 14	33 33 30	135 19 00	190	14.8	G. Sh	*Volvulella ovulina* *Adamnestia tosaensis*
212	do	33 37 50	135 10 30	181	14.3	f. S	*Pyrunculus phialus* *Volvulella ovulina* *Adamnestia tosaensis* *Eocylichna soyoae*
220	July 19	33 07 20 33 15 20	134 10 00 134 01 00	234	11.8	S. Sh	*Adamnestia tosaensis*
221	July 20	33 20 30	135 54 00	209	14.1	m. S	*Ringicula teramachii* *Abderospira punctulata* *Adamnestia tosaensis* *Eocylichna soyoae*
240	Nov. 6	35 10 30	139 32 35	192	15.2	f. S?	*Eocylichna soyoae*
247	Nov. 8	35 09 20	139 10 35	159–128	17.3	M	*Bullina nobilis*
251	Nov. 9	34 59 30	139 10 00	165	15.8	c. S. Sh	*Admnestia japonica*
252	do	34 56 40	139 09 50	289	11.6	m. S	*Acteon siebaldii*
255	Nov. 10	34 46 15	139 05 00	263	13.5	G. m. S. Sh	*Ringicula niinoi* *Bucconia teramachii* *Eocylichna soyoae*

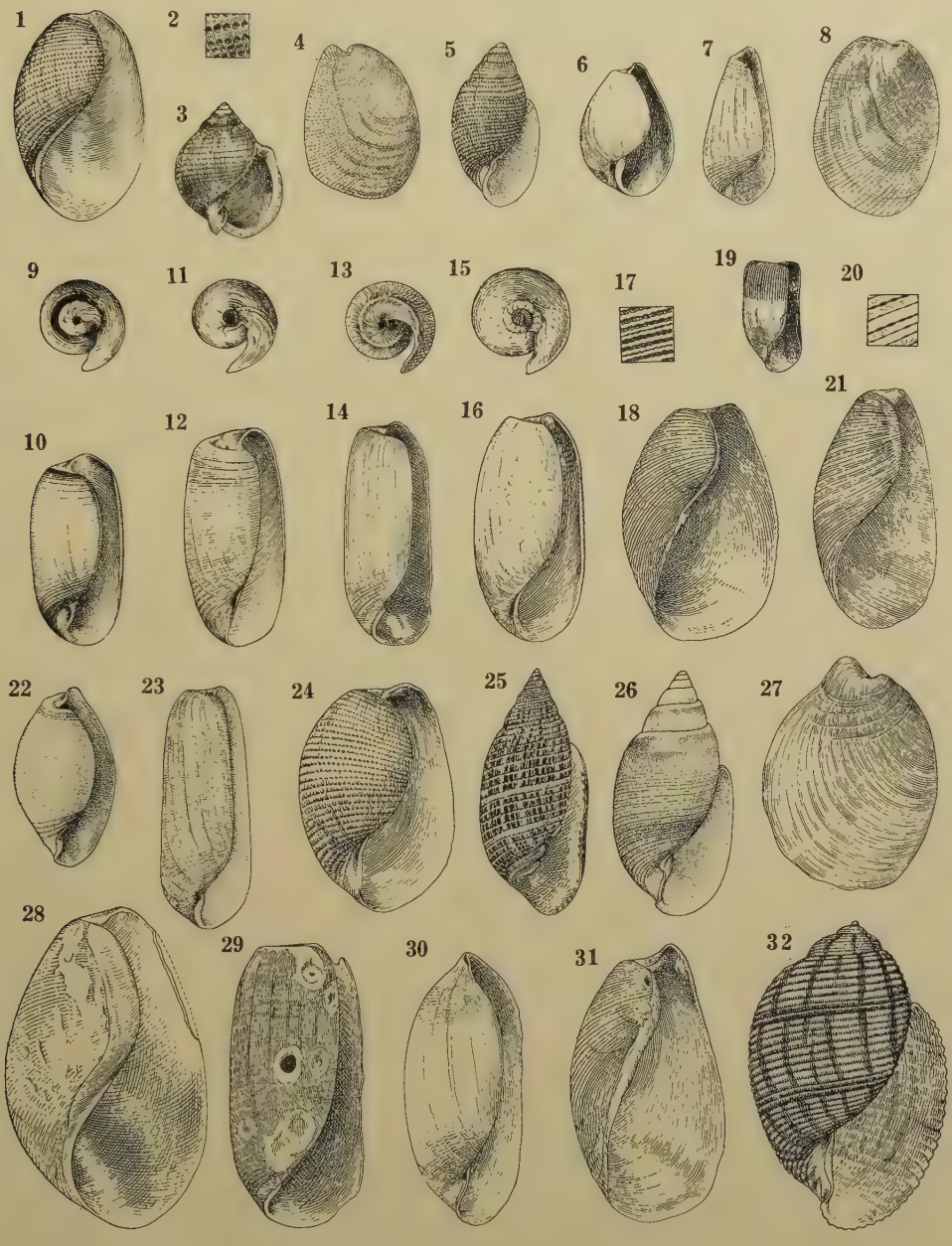
Station No.	Date	Locality		Depth (m)	Bottom Water Temp. (C°)	Bottom character	Species of Cephalaspids
		Lat. N.	Long. E.				
259	1927 Nov. 15	34° 41′ 15″	138° 43′ 00″	188	12.0	s. M	*Acteon siebaldii* *Volvulella ovulina* *Bucconia cumingii* *Bucconia cumingii ventricosa* *Adamnestia tosaensis* *Adamnestia teramachii* *Eocylichna soyoae*
279	1928 July 2	34 42 10	138 30 40	155	12.3	G. S. Sh	*Adamnestia tosaensis*
286	July 4	34 36 10	138 26 30	123	14.3	s. M	*Acteon siebaldii*
295	July 11	30 55 00	131 03 50	154	18.5	S. Sh	*Eocylichna soyoae*
298	do	31 05 45	131 14 35	117	18.9	Sh	*Philine japonica*
300	do	31 18 50	131 19 30	110	17.5	s. M	*Bucconia japonica* *Eocylichna soyoae*
304	July 12	31 24 40	131 34 40	241	14.3	s. M	*Adamnestia tosaensis*
311	July 15	31 49 40	131 42 00	165	15.0	s. M. Sh	*Adamnestia tosaensis*
325	July 21	32 45 00	132 23 30	210	15.2	G. S	*Bucconia cumingii* *Adamnestia tosaensis*
326	do	32 40 10	132 25 15	393	7.9	M. Sh	*Retusa minima* *Volvulella ovulina* *Eocylichna soyoae*
331	July 22	32 30 15	132 46 20	344	8.1	c. S	*Ringicula pilula* *Adamnestia tosaensis*
347	July 29	33 33 00	134 26 31	126	18.8	f. S. M	*Eocylichna soyoae*
352	Aug. 1	33 39 50	135 06 30	154	16.7	S. Sh	*Pyrunculus obesus* *Adamnestia tosaensis*
363	Aug. 9	34 02 20	136 29 00	439	6.6	M	*Pyrunculus phialus* *Eocylichna soyoae*
371	Aug. 13	34 30 15	137 21 45	84	17.3	M	*Ringicula niinoi* *Volvulella ovulina*
395	Feb. 26	33 43 20	135 16 00	46	—	S	*Volvulella tokunagai*
417	1929 July 14	31 10 15	130 26 00	192	13.9	s. M. G	*Ringicula niinoi* *Pyrunculus phialus* *Bucconia japonica* *Eocylichna soyoae*

Station No.	Date	Locality		Depth (m)	Bottom Water Temp. (C°)	Bottom character	Species of Cephalaspids
		Lat. N.	Long. E.				
431	1929 July 16	32° 22′ 00″	129° 25′ 50″	152	16.3	Pum. Sh	*Acteon kawamurai* *Adamnestia tosaensis*
432	July 18	32 40 15	129 18 00	148	16.0	s. M. Sh	*Ringicula yokoyamai* *Pyrunculus obesus* *Eocylichna soyoae*
433	do	32 37 45	129 03 15	168	15.3	s. M. Sh	*Pupa strigosa* *Ringicula yokoyamai* *Pyrunculus obesus* *Adamnestia japonica* *Eocylichna soyoae*
439	July 19	31 52 00	128 01 00	155	15.6	S. Sh	*Adamnestia japonica* *Adamnestia tosaensis*
444	July 20	32 25 45	128 37 30	194	15.0	S. Sh	*Adamnestia tosaensis*
451	July 22	32 43 00	128 11 45	187	14.0	S. Sh	*Eocylichna soyoae*
452	do	32 43 15	127 44 30	154	14.2	m. S	*Adamnestia tosaensis* *Eocylichna soyoae* *Acteocina oyamai*
459	July 23	34 09 00	128 49 45	115	14.6	M. S	*Ringicula yokoyamai*
466	July 25	33 52 00	129 33 15	110	17.8	c. S. Sh	*Adamnestia japonica*
468	do	34 25 40	129 47 00	112	16.1	M. S	*Volvulella ovulina* *Adamnestia japonica* *Eocylichna soyoae*
470	do	33 56 40	130 10 10	73	20.7	S. P	*Adamnestia tosaensis* *Eocylichna soyoae*
471	July 27	34 23 15	130 45 45	90	20.9	M. S. Sh	*Pyrunculus phialus* *Volvulella ovulina* *Adamnestia tosaensis*
477	July 28	34 57 25	129 06 30	99	14.3	P. M. Sh	*Retusa succincta* *Adamnestia tosaensis* *Eocylichna soyoae*
480	Aug. 8	35 28 50	130 18 20	280	1.1	m. S	*Volvulella ovulina*
483	Aug. 9	34 44 50	130 47 10	130	16.3	S	*Pyrunculus phialus* *Volvulella ovulina* *Philine kurodai*
484	do	34 29 30	131 00 20	93	21.0	S	*Ringicula niinoi* *Pyrunculus phialus* *Volvulella ovulina* *Adamnestia japonica*

Station No.	Date	Locality		Depth (m)	Bottom Water Temp. (C°)	Bottom character	Species of Cephalaspids
		Lat. N.	Long. E.				
486	1929 Aug. 11	35° 12′ 20″	130° 57′ 30″	139	5.1	S	*Volvulella ovulina*
488	do	35 35 20	130 46 20	406	1.7	M	*Ringicula niinoi* *Pyrunculus phialus* *Volvulella ovulina* *Bucconia japonica* *Adamnestia japonica* *Eocylichna soyoae* *Philine scalpta*
490	Aug. 12	35 39 00	131 20 10	155	3.8	M	*Eocylichna musashiensis* *Cylichna consobrina*
491	do	35 22 10	131 23 50	112	9.6	M	*Volvulella ovulina* *Adamnestia tosaensis*
493	do	34 57 00	131 52 20	124	18.1	m. S	*Volvulella ovulina* *Volvulella radiola* *Adamnestia japonica* *Eocylichna musashiensis* *Eocylichna soyoae* *Acteocina oyamai*
494	do	35 02 00	132 05 30	110	20.9	m. S	*Adamnestia japonica* *Eocylichna musashiensis*
495	Aug. 14	35 17 00	132 10 20	146	15.2	S	*Adamnestia japonica* *Eocylichna soyoae*
503	Aug. 18	36 05 05	133 16 28	146	16.3	S	*Ringicula niinoi* *Pyrunculus phialus* *Volvulella kinokuniana*
504	do	36 14 45	133 04 45	106	18.6	Sh. G	*Ringicula niinoi* *Eocylichna soyoae*
520	Aug. 23	35 43 00	133 07 30	75	23.3	S	*Ringicula niinoi* *Retusa minima* *Pyrunculus phialus* *Decolifer longispirata*
546	1930 July 20	35 48 30	135 51 35	101	13.0	s. M. G	*Eocylichna soyoae*
549	do	36 13 00	135 42 30	115	15.6	R	*Eocylichna musashiensis*
652	Aug. 24	41 27 08	140 23 00	110	14.0	G	*Cylichna nipponensis*
658	Aug. 30	41 39 00	141 33 27	113	16.3	R	*Cylichna nipponensis*

EXPLANATION OF PLATE XXXVIII

Fig. 1. *Bucconia teramachii* n. sp. (9.0×5.0 mm).
Fig. 2. Enlarged surface sculpture of the same.
Fig. 3. *Ringicula* (*Ringiculella*) *pilula* HABE (7.0×5.0 mm).
Fig. 4. *Philine japonica* LISCHKE (6.3×5.1 mm).
Fig. 5. *Acteon kawamurai* HABE (7.2×3.8 mm).
Fig. 6. *Pyrunculus obesus* HABE (4.5×3.5 mm).
Fig. 7. *Pyrunculus phialus* (A. ADAMS) (4.4×2.3 mm).
Fig. 8. *Philine scalpta* A. ADAMS (14.8×8.8mm).
Fig. 9. *Adamnestia teramachii* n. sp. (apical view).
Fig. 10. *Adamnestia teramachii* n. sp. (4.7×2.5 mm).
Fig. 11. *Adamnestia tosaensis* n. sp. (apical view).
Fig. 12. *Adamnestia tosaensis* n. sp. (9.3×3.6 mm).
Fig. 13. *Eocylichna musashiensis* (TOKUNAGA) (apical view).
Fig. 14. *Eocylichna musashiensis* (TOKUNAGA) (12.0×4.2 mm).
Fig. 15. *Eocylichna soyoae* n. sp. (apical view).
Fig. 16. *Eocylichna soyoae* n. sp. (6.2×3.0 mm).
Fig. 17. *Bucconia cumingii ventricosa* n. subsp. (surface sculpture enlarged).
Fig. 18. *Bucconia cumingii ventricosa* n. subsp. (7.5×4.0 mm).
Fig. 19. *Retusa* (*Coelophysis*) *minima* YAMAKAWA (2.4×1.2 mm).
Fig. 20. *Bucconia japonica* (A. ADAMS) (surface sculpture enlarged).
Fig. 21. *Bucconia japonica* (A. ADAMS) (10.8×5.5 mm).
Fig. 22. *Limulatys angustatus* (GOULD) (4.6×2.5 mm).
Fig. 23. *Adamnestia japonica* (A. ADAMS) (18.2×8.5 mm).
Fig. 24. *Abderospira punctulata* (A. ADAMS) (3.5×2.5 mm).
Fig. 25. *Pupa strigosa* (GOULD) (14.8×5.9 mm).
Fig. 26. *Acteon siebaldii* (REEVE) (19.0×9.5 mm).
Fig. 27. *Philine kurodai* HABE (18.0×13.6 mm).
Fig. 28. *Eoscaphander fragilis* HABE (17.0×10.0 mm).
Fig. 29. *Cylichna consobrina* (GOULD) (12.5×5.6 mm).
Fig. 30. *Volvulella ovulina* (A. ADAMS) (6.4×3.0 mm).
Fig. 31. *Bucconia cumingii* (A. ADAMS) (7.9×4.9 mm).
Fig. 32. *Bullina nobilis* HABE (18.0×13.0 mm).



T. Habe: Mollusca Chiefly Collected by the Sôyô-maru 1.

DENDRONEPHTHYA OF JAPAN, II.

NEW SPECIES AND NEW RECORDS OF *DENDRONEPHTHYA* AND THE ALLIED *STEREONEPHTHYA* FROM KII REGION[1)]

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With Plates XXXIX–XL and 11 Text-figures

Since I have reported twenty nine species of *Dendronephthya* chiefly from the coast of Kii Peninsula in a previous paper (Utinomi, 1952), some new materials have been accumulated. A large part of the material upon which this report is being made was collected by Mr. Torao Yamamoto and myself, mostly at Kusimoto and Tanabe Bay along the Kii coast.

The new collection includes 7 species of *Dendronephthya*, two of which are new to science, and 4 new species of *Stereonephthya*, an allied genus hitherto unknown from Japan. Descriptions of and notes on these new or imperfectly known species from the same or adjacent areas, but from other collections, are also included.

On this occasion I would like to express my cordial thanks to Mr. Torao Yamamoto for his earnest help in collecting the material. Thanks are also due to Prof. T. Kamohara of Kochi University and Prof. T. Ito of Ehime University for the loan of material from the Sikoku area, west of Kii Peninsula.

Genus ***Dendronephthya*** Kükenthal

Bushy or tree-like Nephtheids with the polyps arranged in groups or bundles. The polyps have a supporting bundle which generally projects far out of the head. The canal-walls with or without spicules.

Type species: *Nephthya savignyi* Ehrenberg, 1834 (here designated newly).

1. *Dendronephthya yamamotoi* n. sp.

(Pl. XXXIX, Fig. 1; Text-fig. 1)

1) Contributions from the Seto Marine Biological Laboratory, No. 224.
This study was aided in part by a grant from the Scientific Research Fund from the Ministry of Education.

A beautiful, rigid colony with a polyparium flattened in one plane, though not uniform in outline. Its total height is about 11 cm, of which the upper two-thirds belongs to the polyparium, and the maximum breadth is 7 cm at the top. Sterile stalk, about 4 cm long and 3 cm wide, robust, cylindrical and bears numerous stolons at the base. Polyparium consists of a lower main stem and 2 upper main branches on which short-stalked and widely divergent twigs are borne. These twigs are loosely set and the lowest ones are not foliaceous, so that the stem and branches are almost exposed.

Polyps in groups of 3 to 6 at ends of terminal twigs about 2—3 mm long. Polyp head rather large, about 0.6 mm long and 0.8 mm wide, making an obtuse angle with its short stalk less than 0.5 mm long. It is armoured with the usual crown of 8 close-set points which are found in 5 pairs of subequal spicules, about 0.2—0.3 mm long, finely warted; uppermost one or a pair on lateral sides somewhat longer than others and often a little projecting. Intermediate spicules of one pair, rather large. Tentacles thickly armed with elongate spicules in 2 rows. S. B. strongly

Fig. 1. *Dendronephthya yamamotoi* n. sp. *a*, Polyp; *b*, spicules from stalk cortex; *c*, spicules from canal-walls; *d*, flat antlers from canal-walls. (All×55)

developed, 1 to 3 stronger spicules, finely warted, project beyond polyp head for about 0.5 mm long, where it is smooth. Anthocodial formula:

$$\text{III} = 5\text{ p} + 0\text{ Cr} + \text{strong S. B.} + 1\text{ M}$$

On upper cortex are long flesh-colored spindles up to 5 mm long, transversely arranged. Stalk cortex thickly covered with red or white, strongly warted, curved spindles or boomerangs, spheres and stars, from 0.17×0.08 mm to 0.7×0.2 mm. Canal-walls thickly filled with flat antlers, 0.18 mm long, together with robust spindles, triradiates, quadriradiates and multiradiates with strong rounded warts, up to 2 mm long and 0.3 mm wide which increase in number downwards.

Coloring. Upper stem and main branches flesh-colored, becoming orangish red towards the polyp-bearing twigs. Stalk wholly bright red. Polyp itself pale yellow and point spicules opaque, milky white, while S. B. and stalk spicules orangish red.

Locality. Kusimoto. January 22, 1952. T. YAMAMOTO coll.

Remarks. In the growth-form of colony this is related to *D. speciosa* KÜKENTHAL (1905) from unknown locality and may belong to the *rigida*-group of the Divaricatae as well, but easily separable from the latter in the polyp armature and coloration,

2. *Dendronephthya suensoni* (HOLM)

(Pl. XXXIX, Fig. 2; Text-fig. 2)

Spongodes suensoni HOLM, 1895, p. 35, pl. 2, figs. 14–16.
Dendronephthya suensoni KÜKENTHAL, 1905, p. 586, pl. 28, fig. 19; KÜKENTHAL, 1906b, p. 40.
Dendronephthya aculeata UTINOMI, 1952, p. 171, text-fig. 5, pl. 9, fig. 6.
? *Dendronephthya suensoni* THOMSON & MACKINNON, 1910, p. 185; THOMSON & DEAN, 1931, p. 117, pl. 19, fig. 11.

All examined colonies consist of short divergent branches arising in all directions from a short sterile stalk; the average height of the colony is 8 cm, with the stalk about 2 cm long. Thus they are apparently shrubby in form. Lowest branches of the polyparium about 5 in number, directed downwards and distinctly foliaceous, almost completely covering the stalk.

Polyp head small, about 0.4—0.6 mm long and 0.6—0.8 mm wide, standing at an obtuse angle with its stalk about 0.5—1 mm long. Anthocodial armature consists of thickly set 8 points, of which the uppermost spicule is far projecting and the lower 4 or 5 pairs in chevrons. Besides, there are always 5 or 6 short intermediate spicules between points, converging downwards like a fan. S. B. well developed, composed of 4 or more strong spindles, up to 3 mm long, one of which extends usually for 0.5—1 mm beyond polyp head. These spicules are strongly spinose throughout the length, although often smooth at the end in the extremely projecting one. Polyp stalk densely packed with long or short spicules. Anthocodial formula:

$$\text{IV} = 1\ \text{P} + (5-6)\ \text{p} + 0\ \text{Cr} + \text{strong S. B.} + 3\ \text{M}$$

On cortex of branches and twigs are rather small spindles, about 1 mm long,

with close-set rounded warts. On stalk cortex are however smaller spindles and derivatives, with rather sparsely-set pointed warts. In upper canal-walls are warty spindles, about 0.2—0.28 mm long, which may be somewhat flattened. In lower canal-walls are similar spindles or flat antlers with sparsely-set low pointed warts, larger ones of which become thicker approaching those of lower cortex (0.3—0.4 mm long).

Coloring. Stem and branches white, stalk dirty white. All polyp spicules dark red, becoming orangish towards the stalk and twigs.

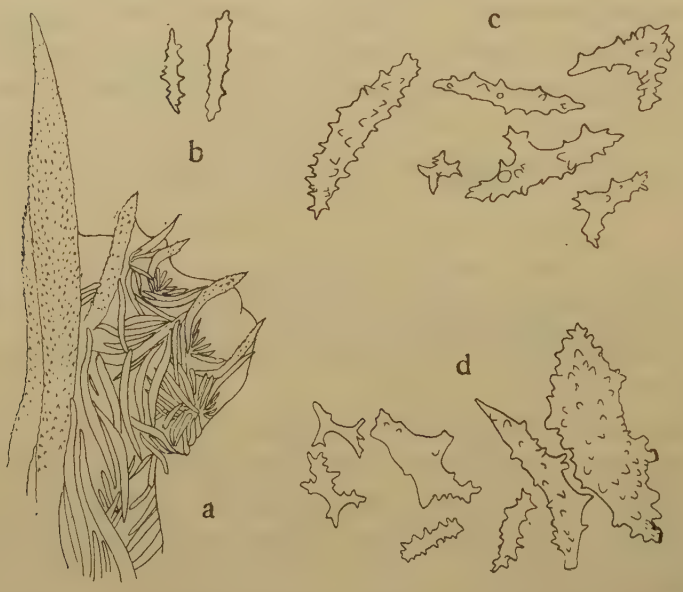

Fig. 2. *Dendronephthya suensoni* (HOLM). *a*, Polyp; *b*, flat rods from canal-walls of branches; *c*, spicules from lower cortex; *d*, spicules from canal-walls of stalk. (*a*×35, *b*–*d*×55)

Localities. Kusimoto. January 29, 1952. T. YAMAMOTO coll.; Taizi. March, 1954. T. HORIHATA coll.

Remarks. In a previous paper I have regarded erroneously a shrivelled dry specimen from Kii-Ôsima as *D. aculeata.* By re-examination I found that it should also be referred to *D. suensoni*, although not in quite agreement with the original description as to the proportion of the stalk to the total height.

This species seems to be widespread along the Pacific coast of southern Japan, from Sagami Bay to Hirado Strait (Hirudo Strasse as originally misspelt). The records of this species from the Indian and Malayan waters seem dubious.

3. *Dendronephthya golgotha* UTINOMI

(Text-fig. 3)

Dendronephthya golgotha UTINOMI, 1952, p. 184, text-fig. 14, pl. 10, fig. 12.

Numerous specimens of three different colorations taken from the same locality may be referable to this species. They measure from 3 cm to 13 cm in total height. As mentioned before, the polyparium is distinctly flattened in one plane in large colonies more than 6 cm in height, whereas in smaller ones not distinctly flattened. The relative length of the sterile stalk varies greatly; in medium-sized colonies it is

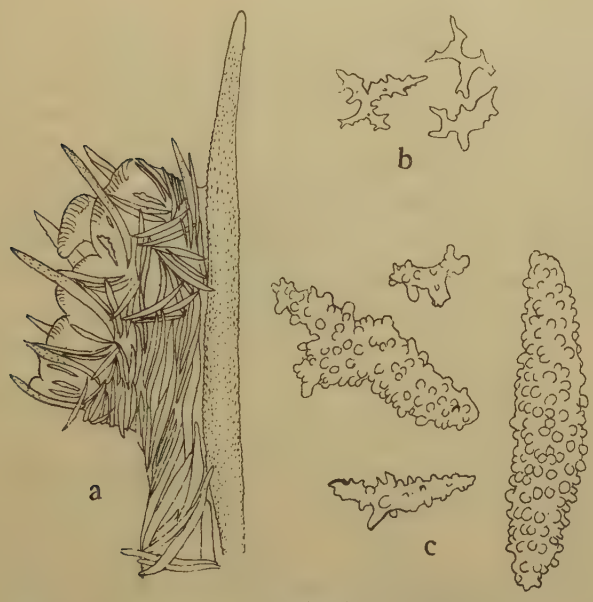

Fig. 3. *Dendronephthya golgotha* UTINOMI. *a*, Polyp; *b*, flat antlers from canal-walls; *c*, spicules from lower cortex. (*a*×35, *b*–*c*×55)

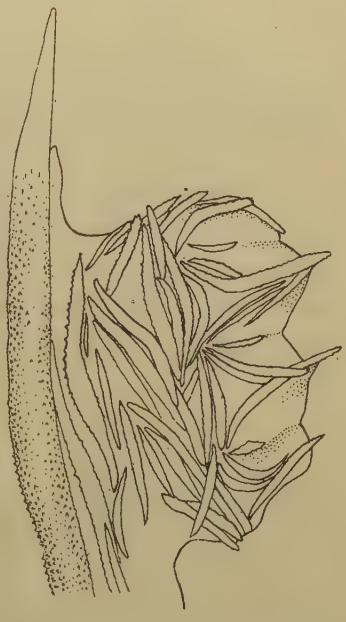

Fig. 4. *Dendronephthya gracillima* KÜKENTHAL. Polyp. (×55)

about one-third of the total height, while in larger ones about one-fifth, being 2—3 cm long. Their lowest branches are exclusively foliaceous and directed downwards, encircling the top of stalk. Main branches are cylindrical, not so tapering distally as in the preceding *suensoni*, and on all the surface are borne a number of short twigs rather loosely.

Polyp armature resembles closely that of *D. suensoni* in general appearance, but the intermediate spicules are less numerous, being only one to three. Crown or lower spicules are thickly disposed either in transverse or converging rows. Cortical spicules in both branches and stalk are covered densely with simple rounded

warts. Canal-walls contain only flat antlers, about 0.25 mm across, which have been overlooked.

Coloring. Seventeen perfect or imperfect specimens here examined can be divided into three forms in coloration. In most of them (10 in number) polyps are carmin red. In two colonies, polyps are dark red, paler downwards to orangish. In five colonies, however, they are quite orange with yellowish white branches. In any case, the sterile stalk is dirty white or greyish.

Locality. Kusimoto. January 29 and April 29, 1952. T. YAMAMOTO coll.

4. *Dendronephthya gracillima* KÜKENTHAL

(Text-fig. 4)

Spongodes flabellifera HOLM, 1895, p. 43, pl. 3, figs. 1–3.
Dendronephthya gracillima KUKENTHAL, 1905, p. 623, pl. 29, fig. 29; KÜKENTHAL, 1906 b, p. 45.
Dendronephthya gracillama (mispr.) ROXAS, 1933, p. 447, pl. 5, fig. 13.

A flattened polyparium alone, 45 mm long and 65 mm wide. It consists of five main branches of subequal length with two flattened blade at the base, which are yellowish white, mottled with orangish hue in places. The stalk is missing. Polyp head large, somewhat flattened laterally, about 0.9 mm wide and 0.6 mm long, standing almost perpendicularly to the stalk up to 1 mm long. Its spicule formula is:

$$\text{VI} = 1\,\text{P} + (3-4)\ \text{Cr} + \text{very strong S. B.} + \left(\frac{1}{2} - 1\right)\text{M}$$

Locality. Kusimoto. January 29, 1952. T. Yamamoto coll.

Previously recorded from Hirado Strait, Kyusyu and Misaki, Sagami Bay and from Legaspi Bay, Philippines.

5. *Dendronephthya flabellifera* (STUDER)

(Pl. XXXIX, Fig. 3; Text-fig. 5)

Spongodes flabellifera STUDER, 1888, p. 72.
Dendronephthya flabellifera KÜKENTHAL, 1905, p. 679, text-fig. C², pl. 31, fig. 49.

A handsome perfect colony of the Umbellate type, 12.5 cm in total height of which the lower 5 cm belongs to sterile stalk. Polyparium flattened in a long oval contour, about 85 mm high, 55 mm wide and 40 mm thick, and covered wholly with compactly massed umbels; its basal branches not foliaceous, unlike STUDER's type. Stalk robust, cylindrical and its lower part bears many filamentous stolons. Another fragment which is only a hemispherical umbel is 4×5 cm in expanse.

Polyp head large, about 0.6 mm long and 1.0—1.2 mm wide, making an obtuse

angle with short polyp stalk, which is 0.5—0.8 mm long and 0.4—0.5 mm wide. Its upper margin is distinctly toothed with eight protruding points, that is a feature characteristic to this species. Point spicules 6—8 in one row, subequal in length and finely warted downwards. No crown spicules. Intermediate spicules usually numerous, up to 5 pairs. Tentacles large, long, thickly armed with elongate rods in 2 rows. S. B. moderately developed; one or two spicules predominate, up to 4 mm long, a little projecting beyond polyp head often for up to 1 mm long, and faintly warted all over. Polyp stalk covered wholly with slender spindles irregularly disposed. Anthocodial formula:

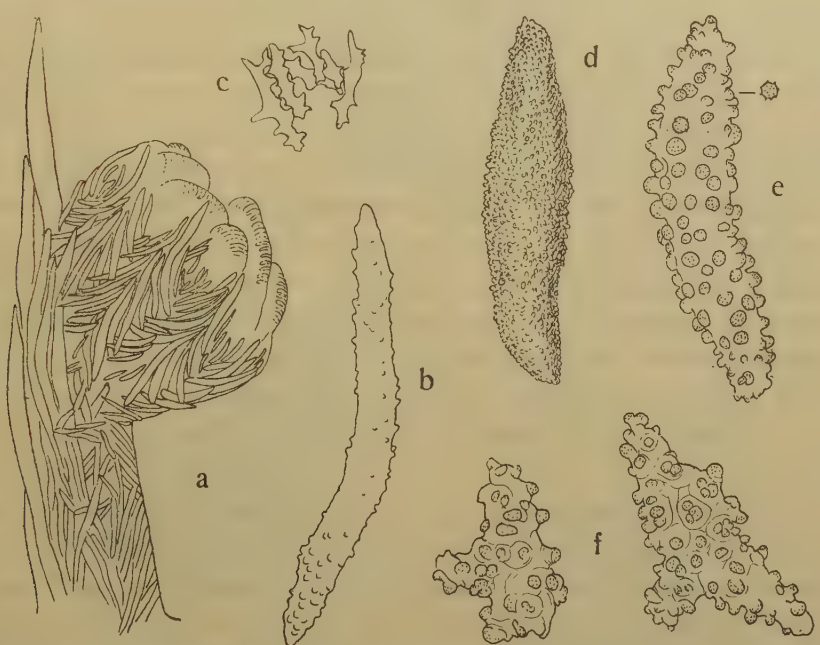

Fig. 5. *Dendronephthya flabellifera* KÜKENTHAL. *a*, Polyp; *b*, uppermost point spicule; *c*, flat rods from canal-walls of branches; *d*, spindle from canal-walls; *e*, small spindle from branch cortex: *f*, spicules from stalk cortex. (*d*×10, *a*×35, *c*, *e*, *f* ×80, *b*×150)

III = (6—8) p+0 Cr+medium S. B.+(2—5) M

On cortex of branches and twigs are large warty spindles up to 4×0.35 mm and smaller spindles from 0.3×0.06 mm to 0.75×0.18 mm. On stalk cortex are short plump spindles, spheres or stars, covered with large rounded warts, dotted on surface, from 0.1×0.05 mm to 0.6×0.2 mm. Upper canal-walls are thickly filled with jagged flat rods, 0.1—0.17 mm long, together with large spindles, 1.5×0.35 mm. In lower canal-walls, flat spicules diminish but spindles occur more numerously. The spicules give place here to blunt-ended curved spindles (3×0.47 mm), triradiates and

quadriradiates.

Coloring. Point and tentacle spicules yellowish white or wholly white, while other polyp spicules together with cortex of twigs yellow. Stem cortex yellowish white, but large part of sterile stalk deep red.

Locality. Kusimoto. January 29, 1952. T. YAMAMOTO coll.

A fragment from the same locality. April 29, 1952. T. YAMAMOTO coll.

Previously recorded from Enosima, Sagami Bay.

6. *Dendronephthya dendritica* n. sp.

(Pl. XXXIX, Fig. 4; Text-fig. 6)

An imperfect specimen expanded in one plane, of which the stalk is lacking, seems to belong to the *spinulosa*-group after KÜKENTHAL's system. But it can not be referred to any of the described species within the group.

From the base of polyparium, where remains a large foliate expansion on one side, arise five cylindrical, flexible, main branches in a palmate form, of which the upper three are larger, 5 to 7 cm long and the lower two smaller, 3 to 5 cm long. The branching of twigs is obviously umbellate. Polyp-bearing twigs are given off sporadically on all surface of the main branches and a few secondary branches. These twigs are short-stalked and scarcely divergent. But they are densely massed together to form a small umbel, each one being only 3—5 mm wide and 3—5 mm high. Those at the terminal ends of branches form a group of umbels with a convex outer surface.

Polyps densely massed in groups of 3—5. Polyp head very small, 0.25 mm long and 0.28 mm wide, borne at a right or acute angle to a very short stalk. S. B. of the entheathing type strongly developed, one or two longer spicules, about 2 mm long, protruding beyond polyp head for a length of about 0.5—1 mm. All points consist of 7—9 pairs of converging spicules, the uppermost of which markedly projecting. Tentacle spicules elongate rods, colorless, closely packed in 2 rows. Anthocodial formula:

$$\text{III} = 1\ \text{P} + (6-8)\ \text{p} + 0\ \text{Cr} + \text{strong S. B.} + (1-3)\ \text{M}$$

On branch cortex are thickly set, colorless, transparent spindles with rounded warts, from 0.35×0.07 mm to 1×0.13 mm, arranged transversely. Canal-walls contain only flat antlers, about 0.1 mm across.

Coloring. Polyps and twigs with their spicules are all orange, while cortex of branches yellowish white.

Locality. Kusimoto. April 29, 1952. T. YAMAMOTO coll.

Remarks. In the mode of branching this specimen resembles *D. spinulosa* of

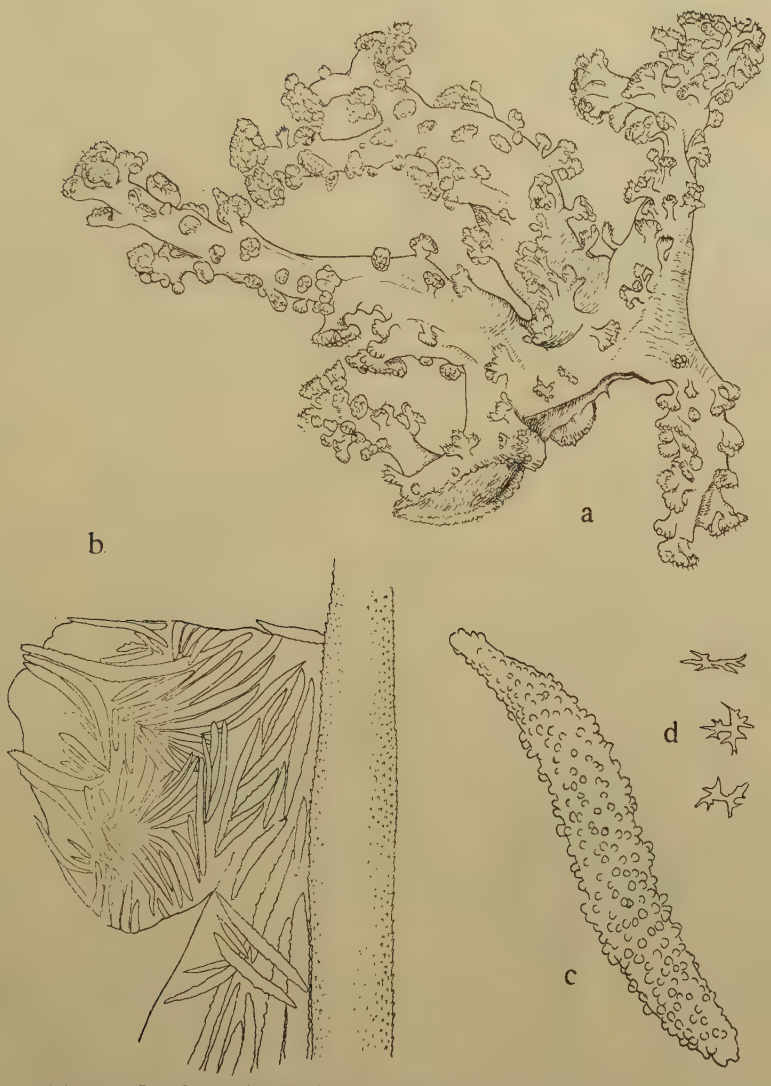

Fig. 6. *Dendronephthya dendritica* n. sp. *a*, Polyparium; *b*, polyp; *c*, spindle from cortex; *d*, flat antlers from canal-walls. (*a*×4/5, *b*×55, *c*–*d*×80)

the Umbellatae and somewhat *D. gardineri* THOMSON & MACKINNON of the Divaricatae, but by no means identical with any one. Very distinctive character of this species for erecting as new is the palmate branches bearing short twigs sporadically on all surface.

7. *Dendronephthya querciformis* KÜKENTHAL

(Text-fig. 7)

Dendronephthya querciformis KÜKENTHAL, 1906a, p. 286; KÜKENTHAL, 1906b, p. 50, text-figs. 40–41, pl. 4, fig. 26.

Three specimens of the Umbellate type from Tosa Bay agree with this interesting species ever recorded from Sagami Bay only. They are uniformly light brown and 5 to 6.5 cm in total height. Two specimens have a long oval polyparium distinctly delimited from the sterile stalk, about half as long as the polyparium, while the other bears a widely diverging stalk as in *D. umbellulifera* KÜKENTHAL and *D. planoregularis* (BURCHARDT). The lowest branches are not foliaceous. Weak spiculation in polyps and cortex is the most remarkable characteristics.

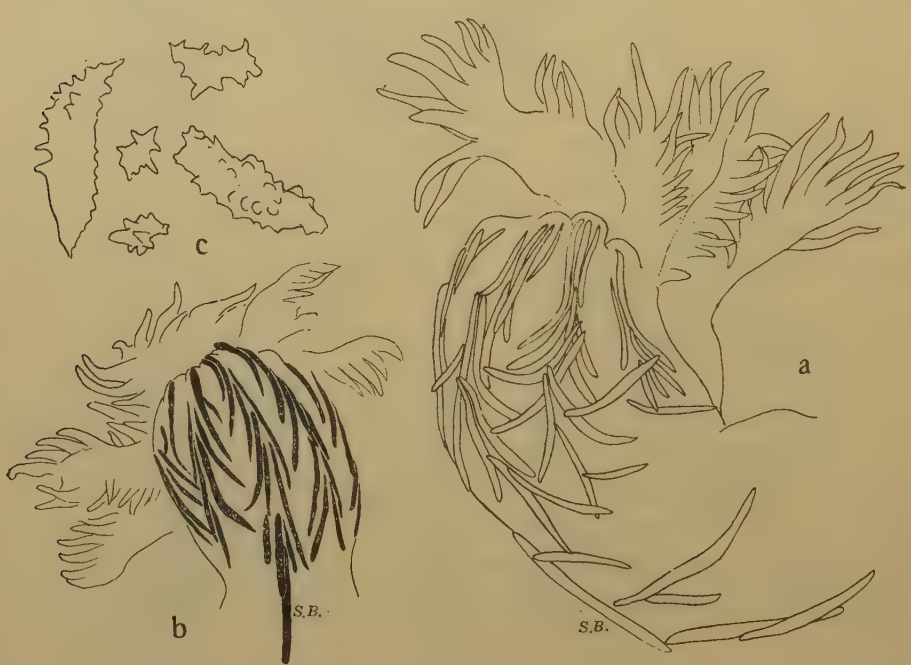

Fig. 7. *Dendronephthya querciformis* KÜKENTHAL. *a*, Polyp, viewed from lateral side; *b*, polyp, viewed from dorsal side; *c*, spicules from lower cortex. *S. B.* spicules of supporting bundle. (*b*×55, *a*×70, *c*×80)

Polyp head very small, longer than wide, up to 0.53 mm long by 0.45 mm wide and its stalk very short, about 0.3 mm long. Anthocodial armature consists of eight double rows of very steeply converging spindles (0.23—0.26 mm long), usually 4 or 5 in each row on laterals and 3 on ventrals. S. B. is very weak and usually does not protrude beyond points on dorsal side; their spicules are very few and slightly

larger than point spicules, 0.3—0.4 mm long and disposed only linearly below dorsal point spicules. All these polyp spicules are uniformly slender and weakly warted. Ventral side of polyp stalk is wholly nude. Tentacles comparatively large, about 0.3 mm long and bear about 10 pairs of 0.2 mm long pinnules on sides and jagged flat rods closely set in two rows on aboral surface. Anthocodial formula:

$$IV = (3-5)\ p+0\ Cr+\text{very weak S. B.}+0\ M$$

On cortex of stem and branches are sparsely-set chalky white, slender spindles, up to 3 mm long; sometimes they are absent. Stalk cortex is thickly covered with small spindles or star-shaped spicules with strong thorns, about 0.08—0.3 mm across. Canal-walls apparently devoid of spicules, although KÜKENTHAL mentions that many tiny flat antlers exist. Since all these spicules are not so perfectly calcified as in other species, tiny spicules, even if practically present, may have been macerated in formalin.

Locality. Tosa Bay, about 100—300 m in depth. 1953. Dr. T. KAMOHARA coll.

Genus ***Stereonephthya*** KÜKENTHAL

Bushy or tree-like Nephtheids with the polyps arranged singly or in small groups directly on the stem or main branches, never forming definite bundles or lobes. The polyps have a strong supporting bundle, usually of the entheathing type. The canal-walls are thin and usually with very few spicules.

Type species: *Stereonephthya papyracea* KÜKENTHAL, 1905 (here designated newly).

As far as can be confirmed, there are at least twenty four species hitherto described. None of them were recorded from Japan, but the following four species are herein described as new.

By a comparative study of the specimens at hand and the described species from literature, some important and taxonomically significant characters, which may or may not exist in common in this group, are found, as follows:

1) Each polyp is firmly supported by a well-developed bundle of large spicules, usually of the entheathing type, with a strongly projecting tip.

2) Ventral side of polyp stalk is usually studded with a number of tiny spicules.

3) Polyp head is usually hanging down on its stalk like a campanulate flower.

4) Generally, polyp head is strongly spiculated on the abaxial (dorsal) side, while poorly spiculated or quite devoid of spicules on the adaxial (ventral) side.

From these characteristics, *Spongodes rakaiyae* described by HICKSON and HILES (1900) from New Britain seems to be a member of *Stereonephthya*, against

KÜKENTHAL's view regarding it as *Dendronephthya*.

1. *Stereonephthya japonica* n. sp.

(Pl. XL, Figs. 1–2; Text-fig. 8)

Colony low and shrubby in form, usually less than 5 cm in total height and 10 cm in maximum spread, in the preserved state. From a short common stalk are given off numerous slender or stout branches in all directions which may again divide into secondary and tertiary branches. In badly developed specimens occurring in unfavourable environment, the branches are often slender and polyps rather sparsely scattered, as in Pl. XL, fig. 2. In well-developed specimens, however, the colony becomes larger and has an erect, distinctly delimited stalk. Generally the terminal branches are thickly grouped, so that the colony appears a compact mass wholly covered with a number of rounded lobes formed by polyps. Therefore, in the preserved or contracted state, the lower portion of branches uncovered with polyps is not visible from outsides.

Polyp head large, up to 1.2 mm long and 0.8 mm wide, stands at an acute angle to the stalk; its oral margin usually wider than the base of attachment. Polyp stalk mostly shorter than 0.5 mm, though often up to 1.5 mm long when isolated; it is very thick and robust, being covered dorsally with a firm supporting bundle of the entheathing type which is of a triangular outline as viewed from dorsad. Its uppermost 2 or 3, up to 2.5 mm long and 0.23 mm wide, together with polyp spicules close to the tip, sometimes project upwards and outwards, giving the tip a pectinate appearance. Anthocodial armature consists of eight double rows of thorny spindles *en chevron*; the spicules in 4 dorsal rows are well-developed and 6—8 in each pair, while those in 4 ventral rows diminish in number as well as in size, though not wholly suppressed. Between points there are many smaller intermediate spicules (rods or spindles up to 0.12 mm long) irregularly arranged.

These spicules, both points and intermediates, are normally glistening yellow, thorny spindles, but sometimes the outermost ones tend to be swollen, opaque, chalky white at the tip, showing the clavate or often ovate to spherical appearance. Such is the case with the spicules in the proximal part of tentacles. The tentacle spicules are usually feebly warted rod, about 0.14 mm long and 0.025 mm wide, transparent, light yellow or colorless, but those towards the base sometimes tend to be larger and opaque white, quite like the uppermost point spicules, so as to be almost indistinguishable from them. The ventral side of polyp stalk is wholly nude just below the head, but further downwards irregularly scattered with very tiny rods, on the average 0.05 mm long, alongside the sloping spicules of supporting bundle.

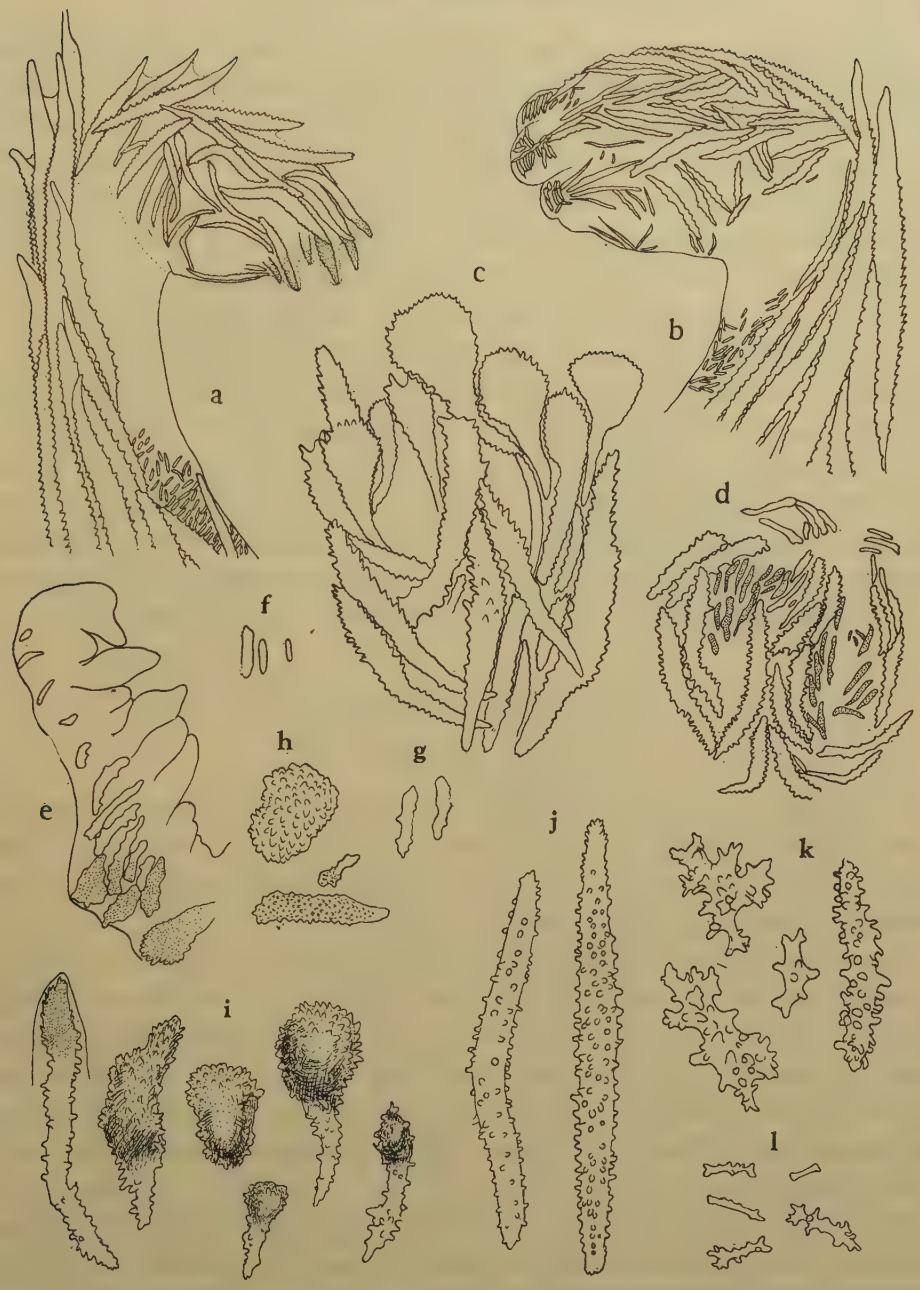

Fig. 8. *Stereonephthya japonica* n. sp. *a*, Polyp with clavate uppermost point spicules; *b*, polyp with normal point spicules; *c*, a part of points, showing the arrangement of clubs and spindles; *d*, a part of polyp armature, showing the arrangement of points, intermediates (dotted) and tentacle spicules; *e*, aboral surface of tentacle; *f*, tiny rods from base of polyp stalk; *g*, translucent median spicules of tentacle; *h*, opaque spicules at the base of tentacle; *i*, point spicules (dotted part is opaque white and the rest lemon-yellow in color); *j*, spindles from branch cortex; *k*, spicules from stalk cortex; *l*, spicules from canal-walls. (*a–b*×35, *c–d*, *j–l*×55, *e–i*×70)

Branch cortex is covered with yellow, slender, warty spindles, up to 1.5 mm long and 0.12 mm wide. Between them are thickly set much smaller, colorless, jagged rods (0.18 mm long) to smooth rods (0.05 mm long), which are similar to those in canal-walls. On the basal cortex are stouter but shorter, yellowish-white warty spindles (up to 0.4 mm long), triradiates or irregular bodies with rounded high warts. Canal-walls are very thin and sparsely filled with small warty or smooth rods, about 0.05—0.15 mm long.

Coloring. As described above, the general color of colony is lemon yellow, though varying from cream color to gold yellow in different colonies.

Localities. Tanabe Bay (type locality) and many other places of Kii, Tosa Provinces, Bungo Channel, Kagosima Bay and Amakusa Island. Besides, I have found a large specimen of this species in the museum of the Zoological Institute, Kyoto University, which was taken from Misaki, Sagami Bay long years ago. On these coasts where I have explored, this species and also the next are commonly found on coastal rocks just below the low tidal belt and apparently more abundant there than common species of *Dendronephthya*, such as *D. gigantea*, *nipponica* and *aurea*.

2. *Stereonephthya rubriflora* n. sp.

(Pl. XL, Figs. 3–4; Text-fig. 9)

This species does not essentially differ from the preceding in the form of colony and the general spiculation, except for the coloration. This is also a low bushy form, though not so compact in appearance. Preserved specimens measure 3—4 cm in height and 7 cm in maximum expanse.

Anthocodial armature in eight double rows of steeply sloping, red or purplish red, slender spindles, of which the two dorsal point rows on each side are closely arranged together and well developed, 5—7 in a row, while the ventral rows are reduced to 1 or 2 in a row or unpaired. The point spicules in the dorsal rows are sometimes swollen at the tip, like a clavate form and here become to be opaque white, without any indication of red hue. Small intermediate spicules also occur between points.

Tentacles have a series of spicules of different coloration; that is, (1) spicules in the proximal part are transversely or obliquely arranged rosy colored warty rods, about 0.14—0.18 mm long and 0.03 mm wide, where are exposed slightly out of the polyp even when the tentacles are retracted, and followed by (2) translucent, flat toothed rods, about 0.07—0.14 mm long and 0.014—0.026 mm wide, transversely arranged in two rows, and terminate to (3) opaque (dark as seen under a lens), oval discs, about 0.017—0.05 mm long and 0.017 mm wide, irregularly arranged.

S. B. is of the entheathing type and composed of short, about 1—2.8 mm long, yellow or yellowish white spindles as many as 20, forming a curved equilateral triangle around the polyp stalk. Its height attains about 2 mm and basal width about 1 mm. The remaining surface of polyp stalk is almost nude, except a number of tiny rods near the base and on the sides.

Fig. 9. *Stereonephthya rubriflora* n. sp. *a*, Polyp; *b*, supporting bundle viewed from dorsal side; *c*, two tentacles with spicules of different coloration (for details see text); *d*, spindle from branch cortex; *e*, spicules from stalk cortex; *f*, spicules from canal-walls. (*a*, *d*, *e*×35, *b*, *f*×55, *c*×70)

Cortical spicules of branches and stalk are almost similar to those in the preceding *japonica* in shape and coloration. In canal-walls are very few spindles, usually 0.17—0.34 mm long, to rods of about 0.08 mm long, with few weak warts.

Coloring. All cortex of branches white to yellow. S. B. spicules also white or yellow, but the anthocodial spicules exclusively red or purplish red. The color of

point spicules is usually purplish when alive, but fades to bright or pale red in longtime preservation.

Localities. The same as *St. japonica.*

Remarks. The general morphological characters of both species described above are almost similar to each other but the coloration is quite distinctive. In the same habitat, both forms are commonly found side by side, and no intermediate form has ever been encountered. The difference in coloration of polyps is too marked to refer them to a mere color variation. For these reasons I regard both forms newly as separate species.

3. *Stereonephthya osimaensis* n. sp.

(Pl. XL, Fig. 5; Text-fig. 10)

This is also a low bushy form of a globular contour, about 2.5 cm in height with a maximum expanse of 5.8 cm. A number of short branches, up to 15 mm long, arise from the small base in all directions and terminate to the rounded summits. Polyps are thickly set on all surface of branches and fewer downwards. The upright stalk is ill-defined and the basal naked portion of branches are not visible from above. Most characteristic at a glance is the coloration, with lemon-yellow polyps

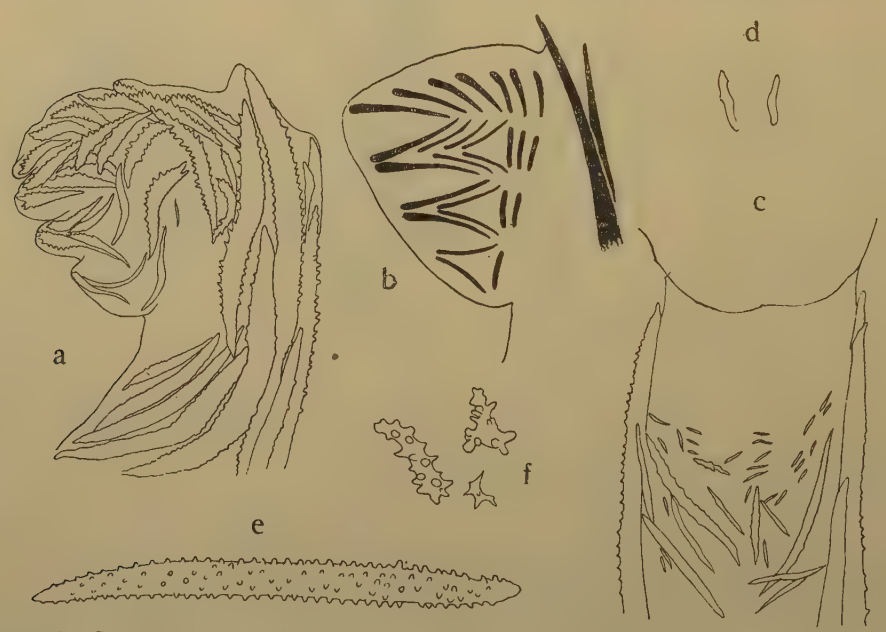

Fig. 10. *Stereonephthya osimaensis* n. sp. *a*, Polyp; *b*, diagram showing the polyp armature; *c*, polyp stalk viewed from ventral side; *d*, spicules from canal-walls; *e*, spicules from branch cortex; *f*, spicules from stalk cortex. (*a*–*c*×35, *d*–*f*×55)

on a pink background of branches, which towards the stalk is paler to colorless.

Polyp head large, about 0.8—0.9 mm long, ovoid in outline, with short and very stout stalk of about the same length; it makes a right or somewhat acute angle with the stalk. Anthocodial armature is very striking, its two pairs of dorsal points being twice as high as the two ventral pairs. In the outermost point on each side of the head, there is only one row of obliquely arranged 7 strong warty spindles, not so paired as in other species. The remaining points on laterals consist of upper converging and basal transverse spicules, both of which decrease to the ventral side in number and size, as schematically figured here. All point spicules are broadened distally and sometimes opaque, chalky white at the clavate end. S. B. is as usual of the entheathing type and composed of 12—18 short plump spindles, about 1.5—1.8 mm long, of which the uppermost one or two project slightly beyond polyp head. All these spicules are light pink, often yellowish at the projecting tip alone. Ventral side of polyp stalk is usually nude, but rarely provided with very few tiny rods, about 0.035—0.12 mm long, downwards. Small tentacle spicules are arranged indistinctly in two rows, and their proximal ones are often larger and opaque as in the preceding species.

Upper cortex is filled with translucent, slender warty spindles, about 0.4—1.8 mm long. On lower cortex of sterile stalk are similar but smaller spindles up to 0.7 mm long and also irregular-shaped or stellate forms with simple warts. Canal-walls contain very few simple rods, mostly 0.12 mm long and 0.018 mm wide.

Locality. A single specimen from the shore of Tuyasima, Kii-ôsima. March 27, 1939. Mr. S. SAKAGUCHI coll.

Remarks. This new species is closely related to the preceding two in general appearance, but clearly distinguishable in the spiculation and coloration.

4. *Stereonephthya hyalina* n. sp.

(Pl. XL, Figs. 6–7; Text-fig. 11)

Two small specimens are attached to a dead coral branch. One of them which is designated as holotype, measures 5 cm in total height and its lower 1 cm belongs to the sterile stalk with a diameter of 6 mm. The remaining one is only 3 cm in total height with 1 cm long stalk.

The colony consists of an upright stem with a weak encrusting base and a few short side branches arising irregularly around the stem. It is very flabby, semi-transparent and wholly snowy white. Few polyps arise either singly or in small groups, so that the naked cortex elsewhere is wholly exposed.

Polyp head itself is about 0.75—0.88 mm long and 0.5—0.6 mm wide, hanging

down like a *Campanula*-flower on the tip of short stalk, about 0.5—1.2 mm long from base to tip. Its armature consists of eight points of which the dorsal two on each side are well-developed in converging rows of uniformly slender spindles, up to 0.35 mm long, and about 7 in one row. Between these points there are many small spicules, about 0.08—0.09 mm long, disposed longitudinally and merged insensibly with tentacle spicules. The ventral two points are rather rudimentary, not forming definitely double rows. Tentacles are about 0.8 mm long and bear 0.05 mm long flat rods, loosely disposed in two rows. S. B. is formed of only 2 to 7 spindles, usually 1—1.8 mm long and sharply pointed at the tip, though slightly projecting beyond polyp head itself. Below the head small flat rods, either smooth or slightly toothed, are scattered about. All these spicules are weakly warted, colorless and almost transparent.

Cortex of stem and branches are loosely covered with slender, colorless spindles

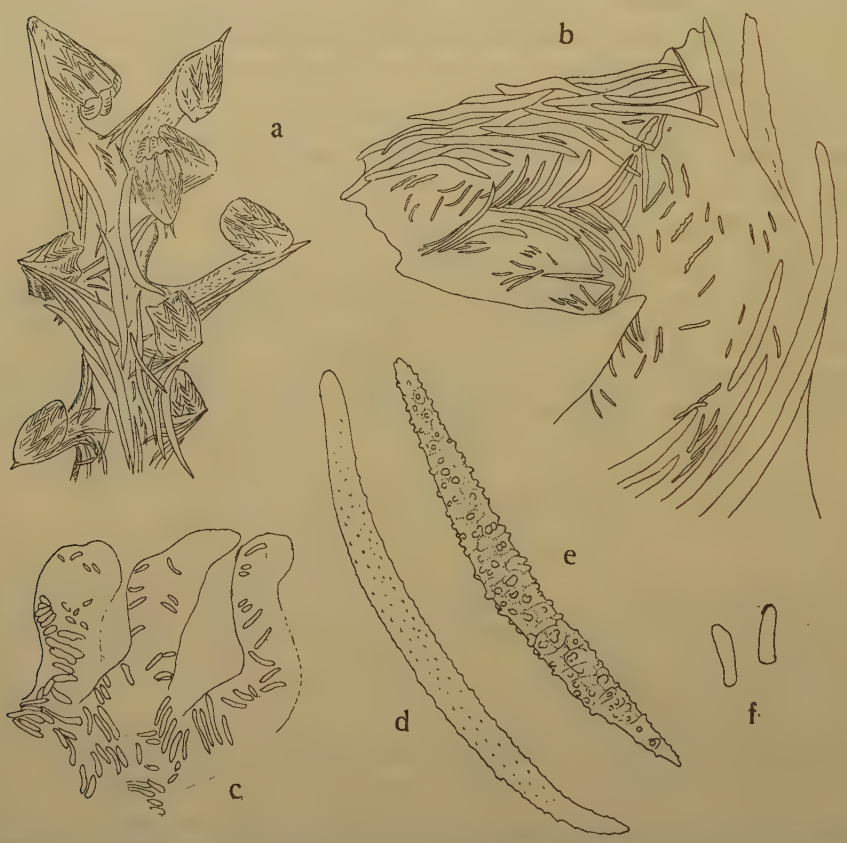

Fig. 11. *Stereonephthya hyalina* n. sp. *a*, Terminal branchlet; *b*, polyp; *c*, three tentacles; *d*, spindle from upper cortex; *e*, spindle from lower cortex; *f*, flat rods from tentacle. (*a*×10, *b*, *d*, *e*×55, *c*×70, *f*×150)

with fine warts, about 1-—2 mm long and 0.05-—0.1 mm wide. On stalk cortex are somewhat shorter spindles covered with stouter large warts, mostly 1.2 mm long and 0.11 mm wide. Canal-walls are very thin and devoid of spicules.

Locality. Not certain.

Remarks. This feebly branched and white colony comes very near to *S. unicolor* (GRAY) and *S. urex* (HOLM) in form of growth, but the polyp armature is quite different.

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(For other references see UTINOMI, 1952).

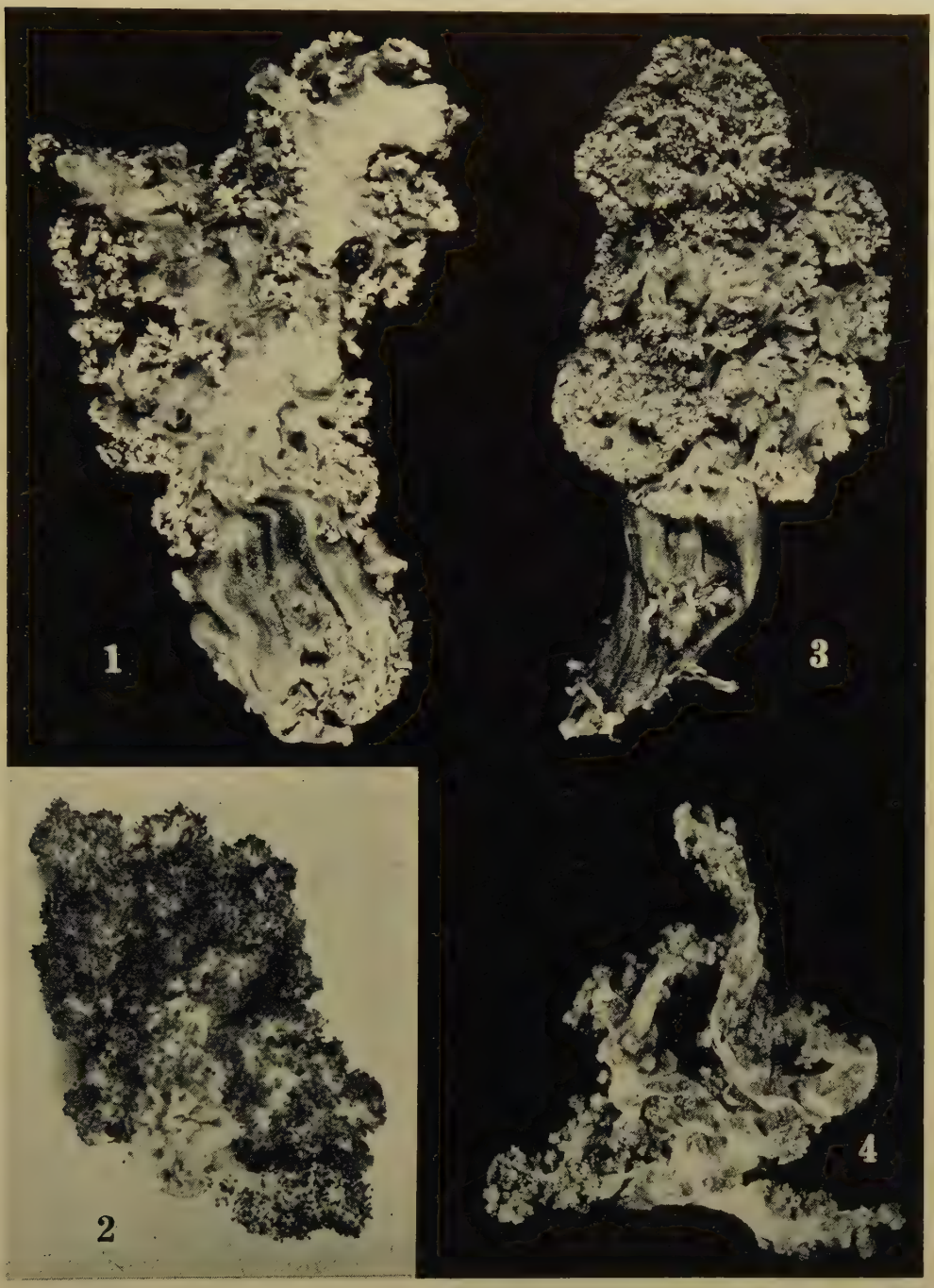
EXPLANATION OF PLATES XXXIX-XL

PLATE XXXIX

Fig. 1. *Dendronephthya yamamotoi* n. sp. (Holotype) ×1.
Fig. 2. *Dendronephthya suensoni* (HOLM). ×1/2.
Fig. 3. *Dendronephthya flabellifera* (STUDER). ×4/5.
Fig. 4. *Dendronephthya dendritica* n. sp., polyparium only. (Holotype) ×2/3.

PLATE XL

Fig. 1. *Stereonephthya japonica* n. sp., compact form, viewed from above. (Holotype) ×2/3.
Fig. 2. The same, slender form, viewed from side. ×1.
Fig. 3. *Stereonephthya rubriflora* n. sp., compact form, viewed from above. (Holotype) ×2/3.
Fig. 4. The same, slender form, viewed from side. ×1.
Fig. 5. *Stereonephthya osimaensis* n. sp., viewed from above. (Holotype) ×4/5.
Fig. 6, 7. *Stereonephthya hyalina* n. sp. (Holotype and paratype) ×5/3.



H. UTINOMI : *DENDRONEPHTHYA* OF JAPAN, II.

H. UTINOMI : *DENDRONEPHTHYA* OF JAPAN, II.

A CHECK LIST OF ECHINOIDS FOUND IN THE KII REGION[1)]

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With one Text-figure

Introduction

The Echinoderm fauna of the Kii region, Middle Japan, has never been made the object of special investigation. A number of species of the Echinoidea have hitherto been recorded from various places along the Kii Peninsula, but such records are scattered in various works dealing with the embryological or ecological subject, and are, naturally, not all of them quite reliable taxonomically.

Whereas recently a preliminary record on the regular-formed echinoids of Wakayama Prefecture has been given by Sakaguchi, basing on the identification by the late echinologist Hayato Ikeda, in "Kisyû Dôsyokubutu", vol. II, no. 2 (1935), no special work on this group has been given till now, excepting my two short mimeographed papers. I therefore thought that a catalogue of all the known echinoids hitherto recorded or described from the Kii region would be of some value to students interested to these animals.

The echinoids given in the present paper amount to 53 species in all, of which 33 belong to the Regularia and 20 to the Irregularia. Among them, 45 species are seen in materials at hand and thus their occurrence has been confirmed by myself. For minor records and detailed structure of species listed in this paper, the student is further referred to the complete and excellent work of Mortensen's "Monograph of the Echinoidea" (1928–1951).

As might be expected from the geographical position, the echinoid fauna of the Kii region, especially in the southern part, is characterized by its pronounced tropical faces and richness in forms. Although no new species is represented in the whole collection, there are some rare and interesting tropical forms, such as *Astropyga radiata*, *Pseudoboletia maculata*, *Diadema Savignyi*, *Echinothrix calamaris*, *Echinothrix diadema*, *Clypeaster reticulatus* and *Peronella minuta*, all of which have not hitherto been recorded from Japan proper with certainty. Besides, the following six regular-

1) Contributions from the Seto Marine Biological Laboratory, No. 225.

formed species which have apparently the northern limit in the Kii region are found rather commonly in the littoral region: *Eucidaris metularia*, (?) *Plococidaris verticillata*, *Stomopneustes variolaris*, *Tripneustes gratilla*, *Parasalenia gratiosa* and *Echinostrephus aciculatus*. Only one species *Echinometra Mathaei*, which is very common here, further extends its range to the southern end of the Izu Peninsula and Bôsô Peninsula (139°50′E, 35°N) but not to the interior of the Sagami Sea; it occurs, however, very scarcely there. Another peculiar species, *Colobocentrotus Mertensii* is known only to occur at Hatizyô Island (139°50′E, 33°05′N) in the east, but not so far found at the above localities in Honsyû.

In bays or inlets along the coast of Kii Peninsula, irregular-formed species, such as *Schizaster lacunosus*, *Echinocardium cordatum*, *Peronella minuta*, *Peronella japonica* and *Fibularia acuta*, are collected by dredging everywhere rather commonly.

In preparing this report, Dr. S. KAWAGUTI (Okayama), Mr. S. SAKAGUCHI (Wakayama), Mr. M. OZAKI (Minabe), Mr. H. OGAWA (Sionomisaki) and Mr. S. YAMAMOTO (Sirahama) assisted on various occasions in collecting the material. Their help is herewith gratefully acknowledged, as is that of Dr. S. NISIYAMA of Simane University and Mr. A. MORISHITA of Kyoto University for identifying some specimens and also procuring literature.

REGULARIA

Order CIDAROIDEA

Family Cidaridae GRAY

1. *Goniocidaris* (*Petalocidaris*) *biserialis* (DÖDERLEIN). (I, p. 173)[1]

Syn. *Stephanocidaris biserialis*, DÖDERLEIN, 1885, p. 80.
Cidaris (*Goniocidaris*) *biserialis*, YOSHIWARA, 1898, p. 248, 1905, Pl. III-3, 4, 5, 6.

Nom. Jap. Togezao-uni.

Material examined. Off Minabe, 100–200 m. 33 specimens (No. E–22, E–48).[2] Off Seto. 1 specimen (No. E–41).

Range. Known only from Japanese waters, from Sagami Sea to off Kagosima Bay and also from off Tango (Japan Sea), in depths of ca. 70 to 360 meters.

2. *Goniocidaris* (*Discocidaris*) *mikado* (DÖDERLEIN). (I, p. 178)

Syn. *Discocidaris* (*Cidaris*) *mikado*, DÖDERLEIN, 1885, p 8.
Cidaris (*Goniocidaris*) *mikado*, YOSHIWARA, 1898, p. 247, 1905, Pl. III-1, 2.

1) Numbers in parentheses refer to MORTENSEN's Monograph.
2) Register number of specimens stored in the collection of the Seto Marine Biological Laboratory.

Nom. Jap. Mikado-uni.

Material examined. Off Minabe, 100–200 m. 17 specimens (No. E–38, E–49).

Range. Known only from Japanese waters, from Sagami Sea to off Goto Islands, in depths of ca. 150 to 700 meters.

3. *Stereocidaris* (*Phalacrocidaris*) *japonica* (DÖDERLEIN). (I, p. 280)

Syn. *Dorocidaris japonica*, DÖDERLEIN, 1885, p. 4.
Cidaris (*Stereocidaris*) *japonica*, DÖDERLEIN, 1887, p. 6; YOSHIWARA, 1898, p. 146, 1904, Pl. I–4, 5.
Cidaris (*Stereocidaris*) *tenuispinus*, YOSHIWARA, 1898a, p. 57, 1898, p. 147, 1904, Pl. I–8, 9, 10.
Anomocidaris tenuispina, A. AGASSIZ & H. L. CLARK, 1907, p. 30.

Nom. Jap. Hutozao-uni.

Collecting record. Seto (KOMAI & IKARI, 1929, p. 121, as *Anomocidaris tenuispina*).

Range. Known only from Japanese waters, from off Kyusyu to Tugaru Strait, in depths of ca. 13 to 700 meters.

4. *Eucidaris metularia* (LAMARCK). (I, p. 386)

Syn. *Cidaris* (*Dorocidaris*) *metularia*, YOSHIWARA, 1898, p. 145, 1904, Pl. I–1.

Nom. Jap. Matukasa-uni. (UTINOMI)

Collecting record. Sué, Kii-ôsima (SAKAGUCHI, 1935, p. 14). Minabe (UTINOMI, 1952, p. 13).

Material examined. Seto, at low tide. 2 specimens (No. E–42). Sio-no-misaki, at low tide. 1 specimen (H. OGAWA coll.).

Range. Widely distributed all over the Indo-Pacific. This is strictly a littoral form, but known as occurring down to ca. 570 m.

5. *Plococidaris verticillata* (LAMARCK). (I, p. 428)

Syn. *Phyllacanthus verticillata*, A. AGASSIZ & H. L. CLARK, 1907, p. 187.
Prionocidaris verticillata, H. L. CLARK, 1921, p. 149.
Cidaris (*Leiocidaris*) *verticillata*, YOSHIWARA, 1900, p. 147, 1904, Pl. I–6.

Nom. Jap. Husizao-uni. (nom. nov.)

Collecting record. Sué, Kii-ôsima (SAKAGUCHI, 1935, p. 14).

Range. Widely distributed all over the Indo-Pacific, from Zanzibar to Samoa and also to Southern Japan. According to OHSHIMA (1947), this species is very common on the coral reef of the Ryukyu Islands, but I have failed to find on the Kii coast.

6. *Prionocidaris baculosa* var. *annulifera* (LAMARCK). (I, p. 437)

Syn. *Leiocidaris baculosa*, DÖDERLEIN, 1887, p. 23.

Leiocidaris annulifera, DÖDERLEIN, p. 24.
Phyllacanthus baculosa, A. AGASSIZ & H. L. CLARK, 1907, p. 15.
Cidaris (*Leiocidaris*) *baculosa*, YOSHIWARA, 1900, p. 147, 1904, Pl. I-11, II-1.

Nom. Jap. Nokogiri-uni. (UTINOMI)

Collecting record. Seto (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 121, as *Cidaris baculosa*). Minabe (UTINOMI, 1952, p. 13).

Material examined. Seto, 25–30 m. 2 young specimens (No. E–19). Susami. 4 specimens (No. E–21). Off Tonda, 50 m. 3 specimens (No. E–56). Off Kusimoto. One large specimen (No. E–64), 49 mm in diameter of test and 95 mm long in longest spine.

Range. Malay Archipelago to Japan, as far north as Sagami Sea, in depths of 0–ca. 250 m. This is often taken by shore seine or lobster-net in the Kii region. The young specimen with short spines resembles the above-mentioned littoral form *Eucidaris metularia*, so that ROXAS (1928) and HAYASAKA (1948) have mistaken as this species.

Associate. A pedunculate cirriped *Trilasmis eburnea* HINDS was once found attached to the spine (HIRO, 1938, p. 477).

Order LEPIDOCENTROIDA

Family Echinothuridae Wyv. THOMSON

7. *Calveriosoma gracile* (A. AGASSIZ). (II, p. 227)

Syn. *Asthenosoma gracile*, A. AGASSIZ, 1881, p. 89.
Asthenosoma longispinum, YOSHIWARA, 1897, p. 5, 1898, p. 249, 1905, Pl. III-8, 9.

Nom. Jap. Harinaga-hukuro-uni. (OHSHIMA)

Material examined. Off Tonda, 80–100 m. One specimen, 130 mm in diameter (No. E–61).

Range. Known only from the Philippines, off Halmahera and from Japan (Sagami Sea), in depths of ca. 160–800 m.

8. *Asthenosoma Ijimai* YOSHIWARA. (II, p. 288)

Nom. Jap. Ijima-hukuro-uni. (OHSHIMA)

Collecting record. Seto (HIRAIWA, 1932, p. 65).

Material examined. Off Tonda, 80–100 m. One specimen, 135 mm in diameter (No. E–62).

Range. Japan (Sagami Sea, Amakusa) to the Moluccan Sea, in depths of ca. 20–120 m.

Order STIRODONTA
Family Stomopneustidae MORTENSEN

9. *Stomopneustes variolaris* (LAMARCK). (II, p. 507)

Nom. Jap. Kuro-uni. (UTINOMI)

Collecting record. Kii-ôsima (SAKAGUCHI, 1935, p. 14). Tôsima, Tanabe Bay (UTINOMI, 1949, p. 55).

Material examined. Tôsima, at low tide. 3 specimens, 21 to 55 mm in diameter (No. E–44).

Range. Indo-Pacific, from East Africa to Samoa and to southern Japan in the north. MORTENSEN (1938) saw a specimen from Izu-ôsima in Sagami Sea, but he says that "it does not appear to occur as a rule in southern Japanese seas."

Family Arbaciidae GRAY

10. *Coelopleurus maculatus* A. AGASSIZ & H. L. CLARK. (II, p. 631)

Syn. *Coelopleurus maillardi* A. AGASSIZ, 1881, p. 60. (*pro parte*)

Nom. Jap. Azuma-uni. (OHSHIMA)

Material examined. Off Minabe, 100–200 m. One spine only (No. E–39) (UTINOMI, 1952, p. 14).

Range. Kei Islands to Japan, as far north as the Korea Strait and Sagami Sea, in depths of ca. 70 to 360 meters.

Order AULODONTA
Family Pedinidae (POMEL) GREGORY

11. *Caenopedina mirabilis* (DÖDERLEIN). (III_1, p. 99)

Syn. *Hemipedina mirabilis*, DÖDERLEIN, 1885, p. 24; YOSHIWARA, 1900, p. 330, 1905, Pl. V–5.

Nom. Jap. Otome-uni. (nom. nov.)

Collecting record. Off Hino-misaki (originally spelled as Hiro Misaki), 191 fms. (=344 m) (CLARK, 1912, p. 221).

Material examined. Off Minabe, 100–200 m. 6 specimens, 12–18 mm in diameter (No. E–24) (UTINOMI, 1952, p. 15).

Range. Known only from Japan, from off Kagosima Gulf to off Kinkasan Light, in depths of ca. 21 to 360 meters.

Family Diadematidae PETERS

12. *Astropyga radiata* (LESKE). (III$_1$, p. 187) (Fig. 1A)

Syn. (?) *Astropyga pulvinata* YOSHIWARA, 1905, Pl. VI-7, 8, 9.

Nom. Jap. Akaoni-gaze. (nom. nov.)

Collecting record. Seto (KOMAI et al., 1927, p. 295, as *Astropyga*?).

Material examined. Off Tonda, depth unlabelled. 2 specimens, both 160 mm in diameter and 55 mm in height (No. E-57, E-60). Recently two additional specimens were obtained alive from off the Laboratory, but unfortunately they were afterwards so putrefied that one could hardly preserve in alcohol due to bad fixisation.

Range. Widely distributed all over the Indo-Pacific region, from East Africa to Hawaii in the east and to Japan in the north, in depths of ca. 2 to 60 meters. No locality is given by YOSHIWARA for his "*Astropyga pulvinata*", which is probably this *A. radiata*.

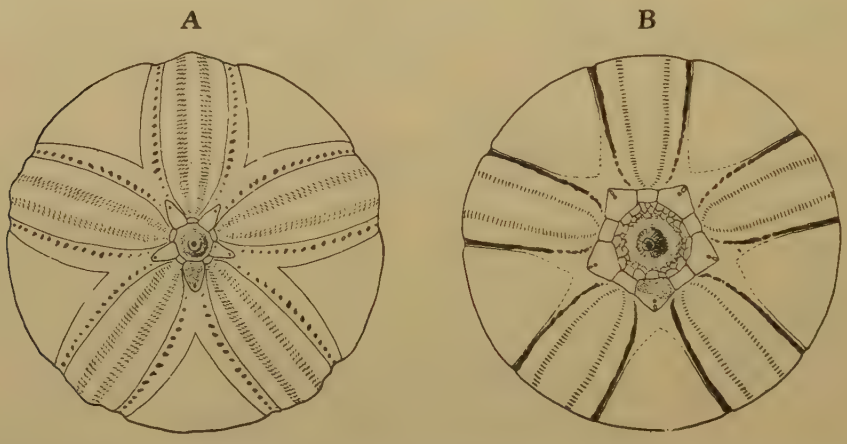

Fig. 1. Aboral side of test of two large diadematids, *Astropyga radiata* (A) and *Chaetodiadema japonicum* (B), showing the arrangement of pore-pairs and blue spots.

13. *Chaetodiadema japonicum* MORTENSEN. (III$_1$, p. 223) (Fig. 1B)

Syn. *Astropyga* sp., YOSHIWARA, 1905, Pl. VI-5, 6.
(?) *Astropyga radiata*, YOSHIWARA, 1905, Pl. VI-3, 4. (*non* LESKE).

Nom. Jap. Yawara-gaze. (nom. nov.)

Material examined. Off Tonda, 80-100 m. 3 specimens, 65 to 90 mm in diameter (No. E-58).

Range. Known only from Sagami Sea (50 m) and off Goto Islands (135 m).

14. *Diadema setosum* (LESKE). (III_1, p. 256)

Syn. *Centrechinus setosus*, H. L. CLARK, 1921, p. 146.
(?) *Diadema Clarki*, IKEDA, 1939a, p. 165.

Nom. Jap. Gangaze.

Collecting record. Seto (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 120; SAKAGUCHI, 1935, p. 16; ONODA, 1936, p. 648).

Material examined. Seto. (No. E–31, E–59) and many living specimens.

Range. Widely distributed all over the Indo-Pacific, from East Africa to Australia and Polynesian Islands and to Japan (Misaki) in the north. Mainly littoral, but goes at least down to ca. 70 m.

Breeding. Usually late in summer, from August to September at Seto.

Parasite. A gastropod *Rosenia tokiokai* HABE is occasionally found on the peristome (HABE, 1952, p. 82).

15. *Diadema Savignyi* (AUDOUIN) MICHELIN. (III_1, p. 265)

Nom. Jap. Aosuzi-gangaze. (nom. nov.)

Material examined. Seto. 2 specimens (No. E–37) (UTINOMI, 1949, p. 56). Common in shallow waters at Seto, but not so abundant as *D. setosum*.

Range. Indo-Pacific region, from East Africa to Easter Island in the east and to southern Japan. Exact locality in Japan proper is not so far given, excepting its occurrence in Ogasawara and Ryukyu Islands.

16. *Echinothrix calamaris* (PALLAS). (III_1, p. 285)

Nom. Jap. Tokkuri-gangaze-modoki. (nom. nov.)

Material examined. Seto, at low tide. 3 specimens, 17–32 mm in diameter (No. E–65) and many living specimens.

Range. Indo-Pacific region, from Red Sea to Hawaii and to southern Japan. Strictly a littoral form, usually living on the coral reef in tropical seas (NISIYAMA, 1942). This species, like *E. diadema*, is hitherto known from Ogasawara Islands (after YOSHIWARA), Ryukyu Islands (after OHSHIMA), and Tokara Islands (TOKIOKA, 1953). In the vicinity of the Laboratory, both species of *Echinothrix* are very common in tide pools, but living deeply concealed underside the rock-cliff in daytime. Anyone has not been awared of its occurrence in common, till Dr. KAWAGUTI collected for the first time at night spring-tide ebb in December of 1952.

17. *Echinothrix diadema* (LINNÉ). (III_1, p. 290)

Syn. *Echinothrix furcarum*, YOSHIWARA, 1898, p. 330, 1905, Pl. VI–1, 2.

Nom. Jap. Gangaze-modoki[1]. (OHSHIMA)

1) Formerly applied to *Echinothrix calamaris*.

Material examined. Seto., at low tide. 6 specimens, 18–30 mm in diameter (No. E-66) and many living specimens.

Range. The same as *E. calamaris.*

Parasite. A gastropod *Rosenia tokiokai* HABE is found on the test.

Order CAMARODONTA
Family Temnopleuridae A. AGASSIZ

18. *Temnopleurus toreumaticus* (KLEIN). (III_2, p. 76)

Nom. Jap. Sansyô-uni.

Collecting record. Wakanoura (YOSHIWARA, 1898, p. 439). Kada, 10–20 m (SAKAGUCHI, 1935, p. 16, as var. *perezi*). Goza, 3 m (ONODA, 1936, p. 646). Yura-wan, 12 m (HABE et al., 1946, p. 8).

Material examined. Seto. 7 specimens, 26–40 mm in diameter (No. E-34).

Range. Widely distributed all over the Indo-Pacific region, from East Africa to Japan, in depths of 0–ca. 45 m. In the Kii Peninsula this species is apparently common in the northern part but becomes scarce southwards.

Breeding. Summer, from June to July at Toba (after SUGIYAMA), while from July to August at Goza (after ONODA).

19. *Temnopleurus* (*Toreumatica*) *Reevesii* (GRAY). (III_2, p. 92)

Syn. *Temnopleurus Reynaudi*, DÖDERLEIN, 1885, p. 18; YOSHIWARA, 1898, p. 440, 1906, Pl. VIII-1, 2, 3, 4.

Nom. Jap. Hari-sansyô-uni. (nom. nov.)

Collecting record. Tanoura and Wakasaura, (YOSHIWARA, 1898, p. 440, as *T. Reynaudi*). Kada (SAKAGUCHI, 1935, p. 15).

Material examined. Seto. 8 specimens, 12–30 mm in diameter (No. E-45). This species is rather common hereabout at low tide than *T. toreumaticus.*

Range. Widely distributed over the Indo-Pacific, from East Africa to northern Japan (Hakodate), in depths of 0–ca. 565 m.

Breeding. July at Seto.

20. *Temnopleurus* (*Toreumatica*) *apodus* (A. AGASSIZ & H. L. CLARK). (III_2, p. 99)

Syn. *Genocidaris apoda*, H. L. CLARK, 1912, p. 297.

Nom. Jap. Kotubu-sansyô-uni. (nom. nov.)

Material examined. Tanabe Bay, 12–30 m. 12 specimens, 6–10 mm in diameter (No. E-17).

Range. Japan (formerly from off Gotô Islands and Sagami Sea), Malay Archipelago to Pemba Strait (East Africa), in depths of ca. 12 to 500 meters.

21. *Salmaciella Dussumieri* (L. AGASSIZ & DESOR). (III_2, p. 139)

Syn. *Salmacis Dussumieri*, A. AGASSIZ, 1881, p. 113.
Salmacis lactea, DÖDERLEIN, 1885, p. 22; YOSHIWARA, 1900, p. 441, 1906, Pl. VIII–13, 14, 15, 16.

Nom. Jap. Nisiki-uni. (nom. nov.)

Collecting record. Kada, 10–20 m (SAKAGUCHI, 1935, p. 15, as *Salmacis dussumieri*).

Range. Distributed from Ceylon to Torres Strait and to Japan (Kagosima), in depths of ca. 10 to 180 meters.

22. *Mespilia globulus* (LINNÉ). (III_2, p. 177)

Syn. *Mespilia levituberculatus*, YOSHIWARA, 1898a, p. 58, 1900, p. 442, 1906, Pl. VIII–20, 21, 22, 23.
Salmacopsis pulchellimus, YOSHIWARA, 1898a, p. 59, 1900, p. 441.

Nom. Jap. Kosidaka-uni.

Collecting record. Seto (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 120; ONODA, 1936, p. 637). Kii coast (SAKAGUCHI, 1935, p. 15).

Material examined. Seto. 5 specimens (No. E–29) and many living specimens. Very abundant all along the Kii coast.

Range. Distributed all over the Malayan waters and southern Japan, as far north as Bôsô Peninsula, from the littoral to ca. 60 m.

Breeding. Summer, usually in July at Seto and more or less later than that of *Anthocidaris crassispina*.

23. *Temnotrema sculptum* A. AGASSIZ. (III_2, p. 249)

Syn. *Pleurechinus variegatus*, MORTENSEN, 1904, p. 84.

Nom. Jap. Hime-uni. (nom. nov.)

Collecting record. Kada, deep bottom (SAKAGUCHI, 1935, p. 16).

Material examined. Seto. 2 specimens, 14–15 mm in diameter (No. E–20). Kada. 6 specimens, 12–14 mm in diameter (No. E–26).

Range. Known only from Japanese waters, from Formosa Channel to Mutu Bay, in depths of 0–ca. 500 m.

Parasite. A *Mucronalia*-like gastropod is found (MORTENSEN, 1943, p. 251).

Family Toxopneustidae TROSCHEL

24. *Toxopneustes pileolus* (LAMARCK). (III_2, p. 472)

Nom. Jap. Rappa-uni.

Collecting record. Seto (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 120). Goza (ONODA, 1936, p. 644). Kii coast (SAKAGUCHI, 1935, p. 15).

Material examined. Seto. 5 specimens (No. E–32, E–55) and many living specimens. Kada. 2 specimens (No. E–36). Very common all along the Kii coast.

Range. Widely distributed all over the Indo-Pacific region, from East Africa to Fiji and to Japan, as far north as Sagami Sea. From the littoral down to ca. 90 m.

Breeding. Early summer, from April to July at Seto and from May to August at Goza (after ONODA).

Commensal. A platyctenid ctenophore *Coeloplana echinicola* TANAKA is rarely found at Seto (TANAKA, 1932). No parasitic gastropod is found.

25. *Tripneustes gratilla* (LINNÉ). (III$_2$, p. 500)

Syn. *Hipponoë variegata*, DÖDERLEIN, 1885, p. 27; YOSHIWARA, 1900, p. 386, 1906, Pl. XIII-9, 10, 11, 12.

Nom. Jap. Sirahige-uni.

Collecting record. Seto (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 121, as *T. grabella*; ONODA, 1936, p. 647). Kii coast, further south than Tanabe (SAKAGUCHI, 1935, p. 15).

Material examined. Seto. One specimen (No. E–53) and many living specimens. Very common in the southern part of Kii coast.

Range. Widely distributed all over the Indo-Pacific region, from East Africa to Australia, Hawaii and to southern Japan, as far north as Kii Peninsula. From the littoral to ca. 75 m.

Breeding. Summer, from July to August.

Parasite. A *Balcis*-like gastropod is found on the test.

26. *Pseudoboletia maculata* TROSCHEL. (III$_2$, p. 532)

Nom. Jap. Madara-uni. (nom. nov.)

Material examined. Seto, at low tide. 4 specimens, 45–60 mm in diameter (No. R–62).

Range. Known from Ceylon, the Philippines, Banda and Timor Seas, in depths of ca. 20–70 m. Its occurrence in Japan has not been recorded as yet.

27. *Pseudocentrotus depressus* (A. AGASSIZ). (III$_2$, p. 541)

Nom. Jap. Aka-uni or Hirata-uni.

Collecting record. Seto (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 120). Kada (SAKAGUCHI, 1935, p. 15). Goza (ONODA, 1936, p. 649).

Material examined. Seto. 11 specimens (No. E–16, 27, 33) and many living

specimens. Kada. 5 specimens (No. E–25).

Range. Known only from southern Japan, from Mutu Bay to Amakusa, from the littoral to ca. 5 m.

Breeding. Later in autumn, from October to December.

Parasite. Three gastropods, *Balcis akauni* HABE, *Rosenia castanea* (DALL) and *Rosenia yamamotoi* HABE are known to live on this species, the last one occurring usually on the young form (HABE, 1952, p. 78, 81).

Family Strongylocentrotidae GREGORY

28. *Hemicentrotus pulcherrimus* (A. AGASSIZ). (III_2, p. 248)

Syn. *Sphaerechinus pulcherrimus*, DÖDERLEIN, 1885, p. 15; YOSHIWARA, 1900, p. 383, 1906, Pl. XIII–1, 2, 3, 4.
Strongylocentrotus pulcherrimus, H. L. CLARK, 1908, p. 304; OHSHIMA, 1947, p. 585.

Nom. Jap. Bahun-uni.

Collecting record. Seto (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 120; ONODA, 1936, p. 649). Kada (SAKAGUCHI, 1935, p. 15). Toba, Prov. Sima (ONODA, 1938, p. 1). All recorded as *Strongylocentrotus pulcherrimus.*

Material examined. Seto. 15 specimens (No. E–23, E–47) and many living specimens. Kada. 15 specimens (No. E–54).

Range. Known only from Japan, from Hakodate to Kagosima, in depths of 0–ca. 45 m.

Breeding. Winter, from January to April at Sugasima (after SUGIYAMA), while at Seto rather later, from March to April.

Family Parasaleniidae MORTENSEN

29. *Parasalenia gratiosa* A. AGASSIZ. (III_3, p. 269)

Nom. Jap. Nagauni-modoki. (Ohshima)

Collecting record. Goza, Katuura, Seto (ONODA, 1938, p. 9); Seto (UTINOMI, 1949, p. 56).

Material examined. Seto, at low tide. 5 specimens, 17–30 mm in long diameter (No. E–46).

Range. Widely distributed all over the Indo-Pacific region, from Zanzibar to Palmira Islands and also to southern Japan, from the littoral to ca. 70 meters. At the Kii coast, it occurs rather commonly on the shore rock, together with *Echinometra Mathaei.* MORTENSEN refers the Japanese specimens to his var. *boninensis* mainly with reference to the slenderness of primary spines. This determination may be reserved in future research.

Family Echinometridae GRAY

30. *Echinostrephus aciculatus* A. AGASSIZ. (III$_3$, p. 306)

Nom. Jap. Tawasi-uni. (UTINOMI)

Collecting record. Seto (ONODA, 1936, p. 646, as *Echinostrephus moralis*; UTINOMI, 1949, p. 56).

Material examined. Seto, 20 specimens, 20–45 mm in diameter (No. E–18, 28, 43) and many living specimens.

Range. Distributed in the Indo-Pacific, from Hawaii to Sulu Islands and to southern Japan (Seto), from the littoral to ca. 50 m.

This species is commonly found, each invariably buried in a hole on the surf-washed or sublittoral rockface, but often dredged from the bottom of the bay. Probably it seems to be able to creep out of the hole for feeding at any time as confirmed in my field observation at night low tide.

Breeding. July at Seto.

31. *Anthocidaris crassispina* (A. AGASSIZ). (III$_3$, p. 328)

Syn. *Strogylocentrotus tuberculatus*, DÖDERLEIN, 1885, p. 19; YOSHIWARA, 1900, p. 381, 1906, Pl. XI–1, 2.
Heliocidaris crassispina, H. L. CLARK, 1912, p. 350; OHSHIMA, 1947, p. 586.

Nom. Jap. Murasaki-uni.

Collecting record. Seto and other localities in Kii Province (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 120; ONODA, 1931, p. 103, 1933, p. 159; SAKAGUCHI, 1935, p. 14, all as *Heliocidaris crassispina*). Wakanoura (YOSHIWARA, 1900, p. 381, as *Strongylocentrotus tuberculatus*).

Material examined. Seto. 5 specimens (No. E–51) and many living specimens.

Range. Very common all around the southern Japanese coast, from Kyusyu to Tokyo Bay. IKEDA (1940) records, however, it from Mutu Bay in the north. Also recorded from Ogasawara Islands, Formosa and Hongkong.

Breeding. Early in summer, from May to July at Seto.

Parasite. Gastropods, *Balcis auratus* (S. HIRASE) and *B. langfordi* (DALL) are often found between spines (HABE, 1952, p. 77). Besides, there are found two crustaceans in association with this species which colored just like the host; one is a crab *Echinoecus petiti nipponicus* MIYAKE (MIYAKE, 1939, p. 90) and the other a shrimp *Athanas kominatoensis* KUBO, although the latter is often found freely.

32. *Echinometra Mathaei* (BLAINVILLE). (III$_3$, p. 338)

Syn. *Echinometra lucunter*, YOSHIWARA, 1900, p. 380, 1906, Pl. X-3-7.

Nom. Jap. Naga-uni. (ONODA)

Collecting record. Seto (KOMAI et al., 1927, p. 295, as *E. lucunter*; KOMAI & IKARI, 1929, p. 120; SAKAGUCHI, 1935, p. 14; ONODA, 1936, p. 641).

Material examined. Seto. 5 specimens (No. E–50) and many living specimens. Very common in southern part of Kii Peninsula.

Range. Widely distributed all over the Indo-Pacific region, from Red Sea to Paumotu and Hawaiian Islands, and from Australia to southern Japan. It extends to the southern end of Bôsô Peninsula and Izu Peninsula, but has not so far been found at Misaki.

Breeding. Usually August at Seto.

33. *Colobocentrotus Mertensii* BRANDT. (III$_3$, p. 429)

Nom. Jap. Zingasa-uni. (OHSHIMA)

Collecting record. Susami and Kii-ôsima (SAKAGUCHI, 1935, p. 14; IKEDA, 1939, p. 195; UTINOMI, 1949, p. 55).

Material examined. Sio-no-misaki, at low tide. 2 specimens (H. OGAWA coll.). One specimen from Ogasawara Islands is preserved in the Laboratory (No. E–40).

Range. Known with certainty only from Ogasawara Islands (Type locality) Formosa, Ryukyu, Tokara Islands, Sibusi (Prov. Ôsumi), Kii Prov. and Hatizyô-zima. At Hatizyôzima, this echinoid is familiar among islanders under the name of "Hanzaru" (WATANABE, 1940).

IRREGULARIA

Order HOLECTYPOIDA

Family Echinoneidae Wright

34. *Echinoneus cyclostomus* LESKE. (IV$_1$, p. 75)

Nom. Jap. Tamago-uni. (nom. nov.)

Material examined. Ezura, southern coast of Tanabe Bay. A single fossil specimen, 35 mm long and 27.7 mm wide (No. R–157). Any living specimen has not been found there (UTINOMI, 1953, p. 43).

Range. Cosmopolitan. In the Japanese seas it is known to occur only at Formosa (YOSHIWARA, 1900; HAYASAKA, 1948), Yaéyama Islands (OHSHIMA, 1947), Tokara Islands (TOKIOKA, 1953) and Kagosima Bay (MORTENSEN, 1948).

Order CASSIDULOIDA

Family Echinolampadidae GRAY

35. *Planilampas sternopetala* (A. AGASSIZ & H. L. CLARK). (IV$_1$, p. 298)

Syn. *Echinolampas sternopetala*, H. L. CLARK, 1917, p. 115; NISIYAMA, 1937, p. 58.

Nom. Jap. Manzyû-uni. (UTINOMI)

Material examined. Off Minabe, 100–200 m. 6 specimens, 75–90 mm long (No. R–52) (UTINOMI, 1952, p. 15).

Range. Known only from the Japanese seas, from Ôhara, E. of Bôsô Peninsula to off Kagosima Gulf, in depths of ca. 100–500 m. Hitherto not recorded from the Kii region.

Order CLYPEASTROIDA

Family Clypeastridae DUNCAN

36. *Clypeaster reticulatus* (LINNÉ). (IV_2, p. 71)

Nom. Jap. Kasuri-takonomakura. (nom. nov.)

Material examined. Minabe. One denuded test, 40 mm long and 32 mm wide, collected by M. OZAKI on the beach (No. R–154) (UTINOMI, 1952, p. 16).

Range. Widely distributed over the Indo-Pacific, from Red Sea and East African coast to Hawaii and to Formosa. It has not hitherto been recorded from Japan proper.

37. *Clypeaster virescens* DÖDERLEIN. (IV_2, p. 96)

Nom. Jap. Ô-takonomakura. (nom. nov.)

Material examined. Off Minabe, 100–200 m. 14 specimens, 90–120 mm in length (No. E–14, E–15) (UTINOMI, 1925, p. 15).

Range. Known only from southern Japan and also from Indo-China, in depths of ca. 100–300 m.

38. *Clypeaster japonicus* DÖDERLEIN. (IV_2, p. 99)

Nom. Jap. Takanomakura.

Collecting record. Seto (TAKI, 1929, p. 157; KOMAI & IKARI, 1929, p. 121). Goza and Katuura (ONODA, 1938, p. 5).

Material examined. Kada. 5 specimens (No. E–12). Seto. Many specimens (No. E–52).

Range. Very common in southern Japan, from the littoral to ca. 75 m.

Breeding. Summer, from July to August (after ONODA).

Commensal. KATO (1944, p. 278) reported a polyclad *Zygantroplana clepeasta* KATO from Misaki as occurring on the test.

Family Fibulariidae DUNCAN

39. *Echinocyamus crispus* MAZZETTI. (IV_2, p. 185)

Syn. *Echinocyamus elongatus*, H. L. CLARK, 1914, p. 61.

Nom. Jap. Botan-uni. (nom. nov.)

Material examined. Sioya, Hidaka-gun. One denuded test, 7 mm long, 5.5 mm wide and 2.3 mm high, collected by T. YAMAMOTO on the beach (No. R–66).

Range. Widely distributed in the Indo-Pacific, from Red Sea to Hawaiian Islands and to southern Japan (Bonin Islands, Korea Strait), in depths of ca. 20 to 564 meters.

40. *Fibularia* (*Fibulariella*) *acuta* YOSHIWARA. (IV$_2$, p. 219)

Nom. Jap. Mame-uni. (OHSHIMA)

Collecting record. Gokasyo-wan and Matoya-wan, 10–30 m (MIYADI & MASUI, 1942, p. 122, 125, as *Fibularia* sp.)

Material examined. Sioya, Hidaka-gun. 10 denuded tests, 6.3–8.5 mm in length, collected by T. YAMAMOTO on the beach (No. R–65).

Range. Recorded only from Japan and Malayan seas, in depths of ca. 10–90 m.

Family Laganidae A. AGASSIZ

41. *Peronella japonica* MORTENSEN. (IV$_2$, p. 277)

Syn. *Peronella decagonalis*, DÖDERLEIN, 1885, p. 33.
Laganum decagonalis, YOSHIWARA, 1900, p. 390, 1907, Pl. XV–9, 10, 11, 12, 13.
Peronella Lesueuri, ONODA, 1938, p. 11; OHSHIMA, 1947, p. 582. (*non* A. AGASSIZ).

Nom. Jap. Yotuana-kasipan.

Collecting record. Wakanoura (YOSHIWARA, 1900, p. 390; TOKUNAGA, 1903, p. 8, as *Laganum decagonalis*). Seto (KOMAI et al., 1927, p. 295, as *L. decagonale*; KOMAI & IKARI, 1929, p. 121, as *Peronella lessueuri*). Goza and Katuura (ONODA, 1938, p. 11, as *P. lesueuri*). Yura-wan, 12 m (HABE et al., 1946, p. 8, as *P. lesueuri*).

Material examined. Hatake-zima (Tanabe Bay). 6 specimens (No. E–8). Tuna-sirazu (Tanabe Bay). 18 specimens (No. E–10).

56 mm long and 49 mm wide in a medium-sized specimen.

Range. Distributed only in southern Japan and Formosa, from the littoral to ca. 50 m. This is the commonest cake-urchin in the littoral all around the Japanese coast.

Breeding. Summer, from July to August (after ONODA).

Parasite. A gastropod *Balcis peronellicola* KURODA & HABE rarely occurs on the peristome (HABE, 1952, p. 77).

42. *Peronella pellucida* DÖDERLEIN. (IV$_2$, p. 281)

Nom. Jap. Usu-yotuana-kasipan. (nom. nov.)

Material examined. Tanabe Bay. 9 specimens (No. E–13). A medium-sized specimen measures 46 mm long, 45 mm wide and 7 mm high.

Range. Recorded only from Japan (from Sagami Sea to SW. of Kyusyu) in depths of 75–550 m.

43. *Peronella minuta* (DE MEIJERE). (IV_2, p. 295)

Nom. Jap. Mame-yotuana-kasipan. (nom. nov.)

Material examined. Off Tonda. 12 specimens, 6.5–12 mm in length (No. E-2). Off Tôsima at Seto, 15 m. 2 specimens, 7 mm in length (No. E-30).

Range. Hitherto recorded only from the Philippines (off Jolo, Sulu Archipelago), in depths of ca. 13–35 m.

44. *Laganum fudsiyama* DÖDERLEIN. (IV_2, p. 338)

Syn. *Laganum diploporum*, A AGASSIZ & H. L. CLARK, 1907, p. 128; H. L. CLARK, 1914, p. 48; NISIYAMA, 1937, p. 56.

Nom. Jap. Huziyama-kasipan.

Collecting record. Off Seto, 344 m (Albatross Station 4965), off Susami, 439–522 m (Albatross Station 4966, 4967).

Range. Common in southern Japanese seas, from Kagosima Gulf to Sagami Sea and also to off Kazusa (Japan Sea), in depths of ca. 50–645 m.

Family Scutellidae GRAY

45. *Scaphechinus mirabilis* A. AGASSIZ. (IV_2, p. 375)

Syn. *Echinarachnius mirabilis*, YOSHIWARA, 1900, p. 392, 1907, Pl. XVI-9, 10; IKEDA, 1940, p. 4.

Nom. Jap. Hasunoha-kasipan.

Collecting record. Seto (KOMAI et al., 1927, p. 295, as ? *E. palma*; KOMAI & IKARI, 1929, p. 121). Ise Bay (MIYADI, 1941a, p. 517, 518).

Range. Widely distributed in Japan, from Hakodate to Amakusa.

46. *Scaphechinus tenuis* (YOSHIWARA). (IV_2, p. 378)

Syn. *Echinarachnius tenuis*, YOSHIWARA, 1898a, p. 61, 1900, p. 392.
Echinarachnius mirabilis, IKEDA, 1935, p. 202. (*in part*).

Nom. Jap. Usu-hasunoha-kasipan. (nom. nov.)

Material examined. Off Seto, probably 12 m. 5 dead specimens (No. E-1). Hatake-zima (Tanabe Bay), at low tide. 6 specimens (No. E-3).

A smallest specimen measures 13.5 mm long, 14.8 mm wide and 2.1 mm high, and largest one measures 35.4 mm long, 36.5 mm wide and 4.4 mm high. The genital pores have not appeared outsides in specimens over 24 mm long, though present insides. According to NISIYAMA (1940), this may be a variety (or subspecies) of *S. mirabilis*.

Range. Distributed only in Japanese waters, from Kagosima to Akkesi, from the littoral to ca. 12 m.

47. *Astriclypeus Manni* VERRILL. (IV$_2$, p. 416)

Nom. Jap. Sukasi-kasipan. (OHSHIMA)

Collecting record. Goza (ONODA, 1938, p. 8).

Range. Recorded only from southern Japan (from Bôsô Peninsula to Kyusyu) in depths of 0–35 m and also from China and Cambodja, Indo-China. This is an inland-water form, as not ever found near Seto on the Pacific coast.

Breeding. Summer, from July to August in the Inland Sea (after ONODA).

Order SPATANGOIDA

Family Pourtalesiidae LOVÉN

48. *Pourtalesia laguncula* A. AGASSIZ. (V$_1$, p. 147)

Nom. Jap. Tokkuri-bunbuku. (OHSHIMA)

Collecting record. Off Kii (A. AGASSIZ, 1881, p. 137).

Range. Known only from Japanese and Malayan deep seas, in depths of ca. 220–1370 m.

Family Loveniidae LAMBERT

49. *Lovenia elongata* (GRAY). (V$_2$, p. 97)

Nom. Jap. Hirata-bunbuku. (OHSHIMA)

Collecting record. Suigesi (?=Suiken, Wakayama City) (YOSHIWARA, 1900, p. 404). Tanabe Bay (MIYADI, 1940a, p. 142).

Material examined. Hatake-zima in Tanabe Bay, in the littoral. 7 specimens (No. E–4).

Range. Widely distributed all over the Indo-Pacific, from Red Sea to southern Japan, as far north as Tokyo Bay. From the littoral down to ca. 90 m.

50. *Echinocardium cordatum* (PENNANT). (V$_2$, p. 152)

Nom. Jap. Okame-bunbuku. (OHSHIMA)

Collecting record. Tanabe Bay (MIYADI, 1941, p. 475, 476).

Material examined. Tanabe Bay, 15–20 m. Many specimens, 12–48 mm in length (No. E–6, E–9).

Range. Apparently cosmopolitan, from the littoral to ca. 230 m. It is very common in shallow waters of bays or inlets and usually buried in sand.

Family Schizasteridae LAMBERT

51. *Schizaster lacunosus* (LINNÉ). (V$_2$, p. 300)

Syn. *Schizaster japonicus*, A. AGASSIZ, 1881, p. 202; YOSHIWARA, 1900, p. 398, 1907, Pl. XVII-10~14.

Nom. Jap. Bunbukutyagama.

Collecting record. Ago-wan, 20 m (MIYADI, 1941b, p. 180). Gokasyo-wan, 10–20 m (MIYADI & MASUI, 1942, p. 122, 124). Kowa-wan, 21 m, Hôza-wan, 23 m (MIYADI & HABE, 1946, p. 4, 10, 11). Yura-wan, 12 m (HABE et al., 1946, p. 6).

Material examined. Tanabe Bay. 2 specimens (No. E–5). Yasima, Prov. Sanuki, 34 m. 4 specimens (No. E–63).

Range. From Japan to East Africa and NE. of Australia. In Japan it is very common on sandy bottoms in depths of ca. 5–90 m.

Family Brissidae GRAY

52. *Brissopsis luzonica* (GRAY). (V_2, p. 397)

Nom. Jap. Bunbuku-modoki. (nom. nov.)

Collecting record. Off Kii (H. L. CLARK, 1917, p. 204). Osaka Bay (MIYADI, 1940, p. 12).

Range. Widely distributed all over the Indo-Pacific, from Red Sea to Hawaii and to southern Japan, in depths of 10 to some 1000 meters.

53. *Brissus* (*Allobrissus*) *Agassizi* DÖDERLEIN. (V_2, p. 520)

Syn. *Brissus latecarinatus*, OHSHIMA, 1947, p. 579. (*non* LESKE)

Nom. Jap. Ô-bunbuku.

Collecting record. Seto (KOMAI et al., 1927, p. 295; KOMAI & IKARI, 1929, p. 121).

Material examined. Seto, at low tide. 3 specimens (No. E–7, E–11) and many living specimens.

Range. Known only from Japan, from Bôsô Peninsula to Amakusa. It lives commonly in shallow waters, buried in sand, and goes down to ca. 10 m.

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DROPLETS FROM THE PLANKTON NET[1]

TAKASI TOKIOKA
Seto Marine Biological Laboratory, Sirahama

XIII. Emergence of a Dense Patch of Chaetognaths near the Laboratory.

When Mr. S. URA, the collector of our Laboratory, was walking about the southern beach near the Laboratory on February 25 of this year, he found a small part of the water coloured reddish near a certain spot of the rocky area. There he tried several hauls by KITAHARA's plankton net, a HENSEN's net modified on a small scale and used most frequently in Japan, and brought me that catch. Mingled with a large amount of fragments of ctenophores, I found many chaetognaths in the sample. They are about a thousand in number and comprise the following 13 species.

Species	Individual number	Percentage
1. *Sagitta hexaptera*	1	—
2. *Sagitta lyra*	44	4
3. *Sagitta enflata*	61	5
4. *Sagitta bipunctata*	1	—
5. *Sagitta robusta*	10	1
6. *Sagitta bedoti*	5	—
7. *Sagitta serratodentata pacifica*	677	61
8. *Sagitta serratodentata atlantica* f. *pseudo-serratodentata*	17	2
9. *Sagitta regularis*	29	3
10. *Sagitta minima*	79	7
11. *Pterosagitta draco*	181	16
12. *Spadella cephaloptera*	1	—
13. *Krohnitta pacifica*	6	1
	1112	

Sag. serratodentata pacifica occupies the most part of the material, next *Pt. draco*

1) Contributions from the Seto Marine Biological Laboratory, No. 226.

and followed by *Sag. minima*, *Sag. enflata* and *Sag. lyra*. The present composition seems to differ considerably from the general constitution of the chaetognath fauna along the Pacific coast of middle Japan. For instance, the material collected during a year from May 1936 to April 1937 from the surface water of Sagami Bay off the Laboratory of the Mitsui Institute of Marine Biology near Simoda is composed of 18 species in the following proportion.

Species	Individual number	Percentage
1. *Sagitta hexaptera*	27	0.3
2. *Sagitta lyra*	71	0.9
3. *Sagitta enflata*	1527	18.5
4. *Sagitta bipunctata*	103	1.2
5. *Sagitta ferox*	395	4.8
6. *Sagitta robusta*	152	1.8
7. *Sagitta bedoti*	1309	15.9
8. *Sagitta pulchra*	23	0.3
9. *Sagitta serratodentata pacifica*	867	10.5
10. *Sagitta serratodentata atlantica* f. *pseudo-serratodentata*	106	1.3
11. *Sagitta neglecta*	848	10.3
12. *Sagitta regularis*	581	7.0
13. *Sagitta minima*	733	8.9
14. *Sagitta decipiens*	6	—
15. *Pterosagitta draco*	194	2.4
16. *Eukrohnia hamata*	44	0.5
17. *Krohnitta subtilis*	13	0.2
18. *Krohnitta pacifica*	63	0.8
19. Damaged individuals or juv.	1182	14.3
	8244	

Sag. enflata and *Sag. bedoti* are the commonest ones, next *Sag. serratodentata pacifica* and *Sag. neglecta*, followed by *Sag. minima* and *Sag. regularis*.

We can learn from the comparison between the two compositions, mentioned above, the distribution of chaetognaths in "Kurosio" is not uniform, but frequently some species may occur in unusual denseness.

XIV. Record of a Scyllarid *Phyllosoma* near Seto.

(Plates XLI–XLIII; Figs. 14, 15)

I have had chances to examine three specimens of a Scyllarid *Phyllosoma*, all collected along the shore near our Laboratory. Two (Nos. 1 and 2) of the three specimens are considered to belong to the same stage of the development, while the other (No. 3) seems to be younger than others.

No. of Specimen	Date	Carapace	
		Length	Breadth
1	Dec. 28, 1953	30 mm	32 mm
2	May 12, 1952	30	33
3	"	23	26

Descriptions on Nos. 1 and 2

Carapace well developed; nearly quadrate in outline, with rounded corners, bearing a large sinus in the middle of the anterior side and a pair of slight sinuses along the posterior side and covers the most part of thorax leaving the last thoracic segment and the posterior part of the preceding segment out of it (Fig. 14). There is a stout spine at each side of the anterior sinus on the dorsal surface, in rear of which a crest runs backward to the posterior margin of carapace. Each longitudinal crest is divided into anterior and posterior parts, which are nearly equal in length and both slightly convex outwards; posterior parts marked with 10–11 serrations in No. 1 and with 11–12 ones in No. 2. These serrations are all pointed anteriorly. An oblong prominence (Pl. XLI, fig. 6) on the dorso-median line between the pair of stout spines mentioned above, with a spinule at each side of the anterior edge. Liver diverticula number 57–61 in No. 1; two anterior branches are issued from the point near the base on each side: the outer branch ramified outwards into a considerable number of diverticula, while the inner one, thinner than the other, reaches near the antennal gland (Fig. 15 Ant. gl.; Pl. XLI, fig. 3 ANT GL.) without any ramification on its way.

Thorax is about 1/2.5 of carapace in length and slightly larger than 1/3 of carapace in breadth (Fig. 15).

Abdomen consists of 7 segments, the articulation between the thorax and the first abdominal segment is not yet completed. It is 16 mm long in specimen No. 1. Pleura of 1–5 abdominal segments protrude laterally (Pl. XLI, fig. 7); ending in 1 abd. seg. in an acute tip, obtuse, but with a spine at the tip and several teeth along

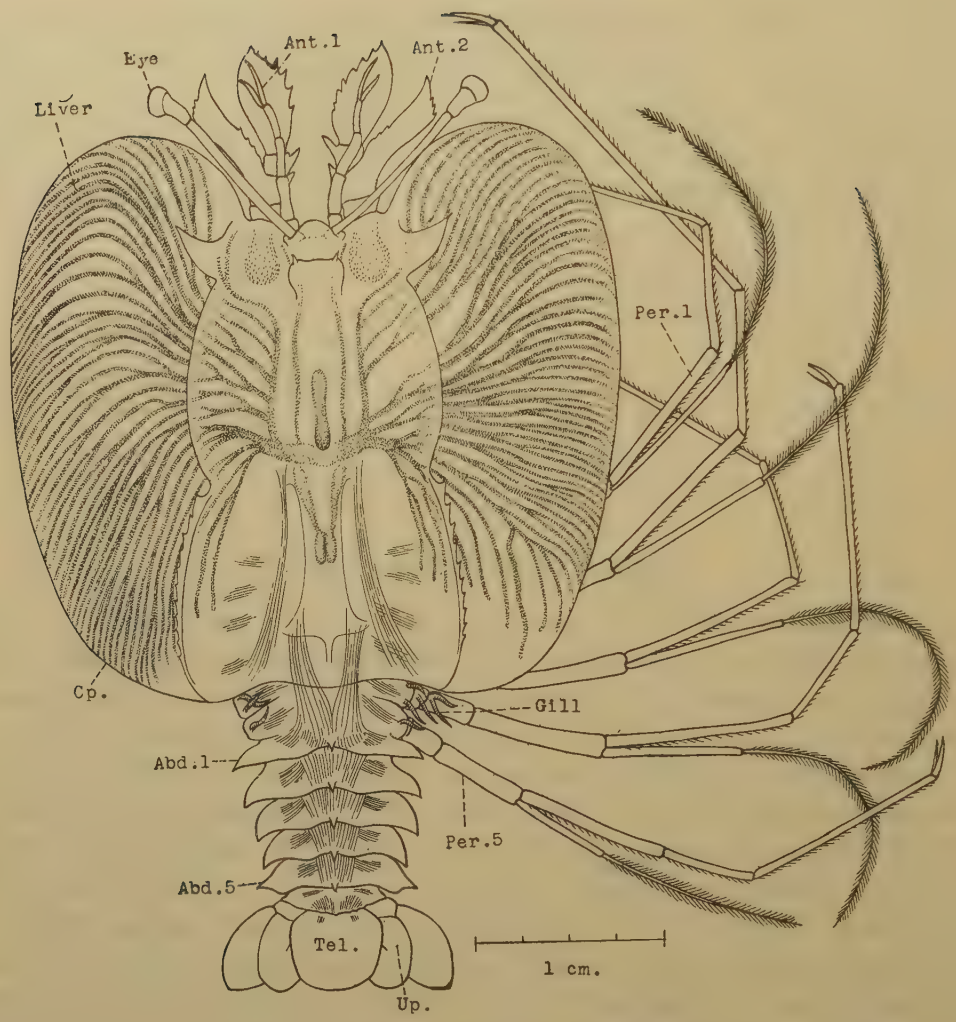

Fig. 14. *Phyllosoma utivaébi* nov. Dorsal side.

the posterior margin in 2 and 3 abd. seg., truncate and with a spinule at each antero- and postero-distal corner and several teeth along the posterior margin in 4 abd. seg., like the preceding pleuron, but with a large spine at the postero-distal corner in 5 abd. segment. A dorsal spine is found at the middle of the posterior margin of each of 1–5 abd. segments; that on the 5 abd. segment is largest. The 6 abd. seg. is furnished with about a dozen serrations along the posterior margin and provided with a small spine at each postero-distal end. Telson broader than long, with a seta near the middle of each lateral side. Both thorax and abdoman are sprinkled with minute papillae on the ventral surface.

Appendages: Eye (Pl. XLI, fig. 1) 11 m long including the stalk in No. 1 speci-

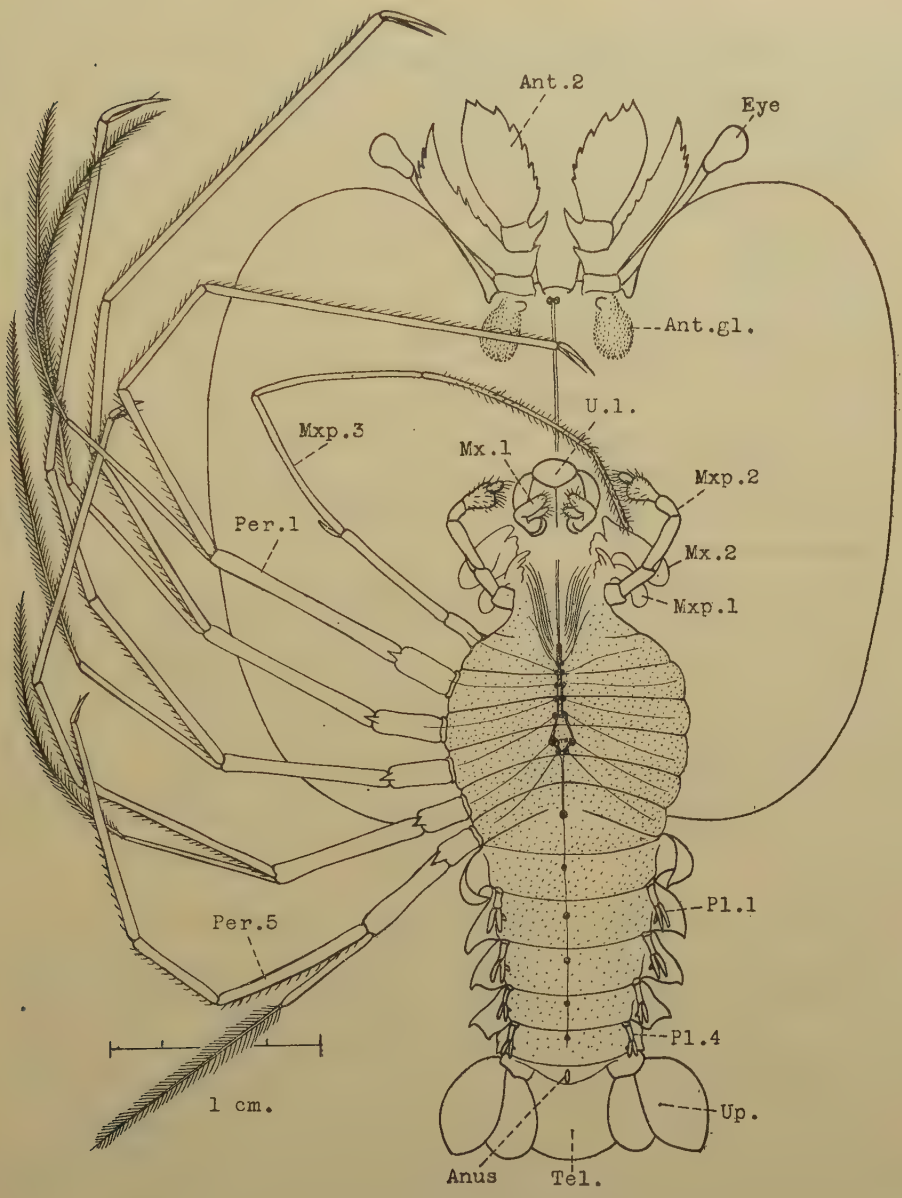

Fig. 15. *Phyllosoma utivaébi* nov. Ventral side.

men; antennule 10 mm and antenna 9 mm. Length of each segment of 1–5 pereiopods is shown in p. 365. Length of other appendages and proportion of each segment may be measured on figures which are all drawn by ABBE's drawing apparatus.

Antennule: (Pl. XLI, fig. 2) The peduncle consists of 3 segments, the basal segment is longest and the distal one is shortest. Flagellum slightly shorter than

inner ramus.

Antenna: (Pl. XLI, figs. 3 and 4) Four segmented. The inner distal end of the second segment and the inner side of the third segment form respectively a stout spine. The outer side of the second segment prominently protrudes antero-laterally; this prominence is slightly longer than the 4 th segment. The distal end bears 4 stout teeth and several spinules; also several small spines along the antero-basal edge of this prominence. The 4 th segment roughly oval in form and with 7 stout teeth along the inner edge. Four minute setae on the third segment and two ones on the second segment on the ventral surface.

Upper lip: (Pl. XLI, fig. 5, U. L.) Somewhat rounded elevation.

Mandible: (Pl. XLI, fig. 5, MD.; Pl. XLIII, figs. 7–9) About 40 short bristles along the blade edge, the anterior end of which is thickened like a chisel and the posterior end forms a papillated conical prominence. There is an obtuse prominence near the middle of the anterior margin, the neighbourhood of which is coloured faintly purplish-brown.

Lower lip: (Pl. XLI, fig. 5 Low. L.,; PL. XLIII, fig. 10) Each lip roughly oblong in outline and furnished with fine hairs along the anterior part of the inner margin.

Maxillula: (Pl. XLI, fig. 5 MX 1; Pl. XLIII, fig. 11) Biramous, both rami unsegmented; the outer ramus has a seta at the middle of the outer side besides 15–20 ones at the distal end.

Maxilla: (Pl. XLII, fig. 8) Consists of a short but broad appendage and a large leaf-like lobe. The distal end of the appendage is provided with three knob-like prominences; the anterior end of the lobe is bluntly pointed, while the posterior end is rounded.

1st Maxilliped: (Pl. XLII, fig. 9) A finger-shaped appendage with an oval lobe at the basal portion of the outer side. There are a slender protuberance at the inner base of the finger-shaped portion and two rounded prominence below the preceding protuberance, of which the lower one is rather inconspicuous.

2nd Maxilliped: (Pl. XLII, fig. 10) Consists of 6 segments, of which the terminal one forms a thick dactylus. There is a short appendix articulated to the distal end of the basis outwards the 3rd segment, which corresponds apparently with the rudimentary exopodite. The 3rd segment with several short setae along the outer margin. The 5 th segment thickly furnished with bristles.

3rd Maxilliped: (Pl. XLII, fig. 11) Very long, slender and 6-segmented. There is a short rudimentary exopodite at the outer distal edge of the long basis. The 5th and the terminal segments are both thickly setose.

Pereiopod: (Pl. XLII, fig. 12) Five pairs of pereiopods are 6-segmented, each has a well developed exopodite (Pl. XLII, fig. 13) which is articulated to the outer

distal edge of basis, consists of the basal segment and the plumose distal segment and plays the rôle to keep the animal floating by its natatory movement. The third to the 5 th segments are furnished with bristles along the outer side,the 5 th segment has a long spine at the inner edge of the distal end. The terminal dactylus curves slightly and with a thin spine near the middle of its convex margin. The distal end of each coxa protrudes into a spine on the ventral surface.

No. of Pereiopod	Length of Coxa	Basis	3rd Seg.	4th Seg.	5th Seg.	Dactylus	Exopodite	
							Basal Seg.	Distal Seg.
1	3 mm	10 mm	9 mm	6.5 mm	17 mm	2.5 mm	9.5 mm	17 mm
2	3.5	9	10	7.5	19	3	9.5	18
3	3	8	10	6.5	17	3	8.5	17
4	2.5	7.5	10	5.5	13	2	7.5	14
5	2	5	8	5	11	2	5.5	11

(Specimen No. 1)

1	3	10	9	7	17	2.5	10	17
2	3	9	10	6.5	18	2.5	9.5	17
3	2.5	7.5	10	6	17	2.5	9	16.5
4	2.5	7	10	5.5	14	2	7.5	14.5
5	2.5	5.5	8	4.5	11	2	6	12

(Specimen No. 2)

Gill: Occur in the following number as tabulated below:

Appendages	Pleurobranchia	Arthrobranchia	Podobranchia
2nd Maxilliped	—	1	1 (bifid)
3rd Maxilliped	1	1	1 (»)
1 Pereiopod	1	1	1 (»)
2 »	2	1	1 (»)
3 »	2	1	1 (»)
4 »	2	1	1 (»)
5 »	1	—	—

Pleopod: (Pl. XLII, fig. 14) Four pairs of pleopods occur on 2–5 abd. segments. Each pleopod consists of 2 segmented basipodite and unsegmented exo- and endopodites.

A short appendix interna is found near the middle of the inner side of the endopodite.

Uropod: (Pl. XLII, fig. 15) Both inner and outer leaves fan-shaped, the margin furnished with many minute setae.

Thoracic ganglion: The second to the 8th ganglions are discernible clearly, 2 and 3 ganglions (G. 1 and G. 2 in figure) are smaller than 4–8 ganglions (G. 3–G. 7 in figure). The distance between parallel longitudinal cords is very large between 6 (G. 5) and 7 (G. 6) ganglions as shown in Pl. XLIII, fig. 1.

DESCRIPTIONS ON NO. 3 SPECIMEN

This specimen resembles so closely Nos. 1 and 2 that I can find merely the following differences. (1) The body is smaller, the total length is 34 mm. (2) There are 5–8 serrations on each posterior part of the longitudinal crests on the carapace. (3) The distal end of the large outer projection of the 2nd segment of antenna bears distally 5 stout teeth, the 4th segment with 5 stout and 2 minute serrations along the inner margin. (4) The anterior end of the blade edge of mandible (Pl. XLIII, figs. 2 and 2′) forms a spine-like protuberance, the posterior end swells slightly, but not forming a distinct prominence; a blunt spine on the outer margin is very prominent. (5) Lower lip (Pl. XLIII, fig. 3) is not yet furnished with fine hairs along the edge. (6) There is only one rounded prominence below the slender protuberance at the inner base of the finger-shaped portion of 1st maxilliped (Pl. XLIII, fig. 6). The length of each segment of pereiopods is shown below:

No. of Pereiopod	Length of Coxa	Basis	3rd Seg.	4th Seg.	5th Seg.	Dactylus	Exopodite	
							Basal Seg.	Distal Seg.
1	2 mm	6.5 mm	6.5 mm	3.5 mm	11 mm	1.5 mm	6 mm	11 mm
2	2	5	6.5	4.5	13	2	6	10.5
3	1.5	5	7	3.5	11	2	5.5	11
4	1.5	4	6	3	8.5	1.2	5	9.5
5	1.2	3.5	5.5	2.5	6.5	1	4	7.5

(Specimen No. 3)

Gills occur as in Nos. 1 and 2, except for the second maxilliped which bears merely a podobranchia, that on the left side is bifid, while that on the right is simple.

For the differences mentioned above, the specimen No. 3 may be considered to belong to the stage earlier than that of Nos. 1 and 2. Lastly, it is very possible that this large *Phyllosoma* belongs to *Ibacus ciliatus* (v. SIEBOLD) which is found rather

commonly in this district, because the shape of the antenna and the existence of a pair of longitudinal crests on the carapace in this *Phyllosoma* are very like those in that scyllarid. Here, for the convenience to record the material, the present *Phyllosoma* is named provisionally *Phyllosoma utivaébi* (*Utiwaébi* is the Japanese name of *Ibacus ciliatus*).

The most closely related one with the present form is *Phyllosama guerini* DE HAAN described and figured in v. SIEBOLD's "Fauna Japonica". In *Ph. guerini* of 1½″ long, antenna 5–segmented, the inner sides of 2–4 seg. are protruded respectively into a stout spine and 5 seg. of each pereiopod has a longitudinal furrow along the median line on each side. These features, at least the last one, are possibly regarded as artefacts, because the sole individual of *Ph. guerini* was a dried specimen. However, the ultimate decision must be given solely by re-examination of the type specimen of *Ph. guerini*.

ABBREVIATIONS

Abd. 1–5.....Abdominal segments
Ant. 1 .....Antennule
Ant. 2 .....Antenna
Ant. gl. .....Antennal gland
Cp. .....Carapace
Mx. 1 .....Maxillula
Mx. 2 .....Maxilla
Mxp. 1–3.....Maxillipeds
Per. 1–5 .....Pereiopods
Pl. 1–4.....Pleopods
Tel. .....Telson
U. l.....Upper lip
Up. .....Uropod

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EXPLANATION OF PLATES XLI–XLIII

Plate XLI

Phyllosoma utivaébi nov. Specimen No. 1.

Fig. 1. Eye and eye stalk.
Fig. 2. Right antennule, dorsal.
Fig. 3. Right antenna and antennal gland, ventral.
Fig. 4. Right antenna of Specimen No. 3, ventral.
Fig. 5. Mouth part.
Fig. 6. Median dorsal prominence near the anterior end of the carapace.
Fig. 7. Abdomen, dorsal.

ABD. 1–6 .....Abdominal segments
ANT. GL. .....Antennal gland
GL. AP.....Aperture of antennal gland
LOW. L.....Lower lip
MD. .....Mandible
MX. 1.....Maxillula
U. L. .....Upper lip

Plate XLII

Phyllosoma utivaébi nov. Specimen No. 1.

Fig. 8. Maxilla.
Fig. 9. 1st Maxilliped.
Fig. 10. 2nd Maxilliped.
Fig. 11. 3rd Maxilliped.
Fig. 12. Right 4 th pereiopod, dorsal.
Fig. 13. Exopodite of the same leg.
Fig. 14. Left 1st pleopod, ventral.
Fig. 15. Left uropod, dorsal.

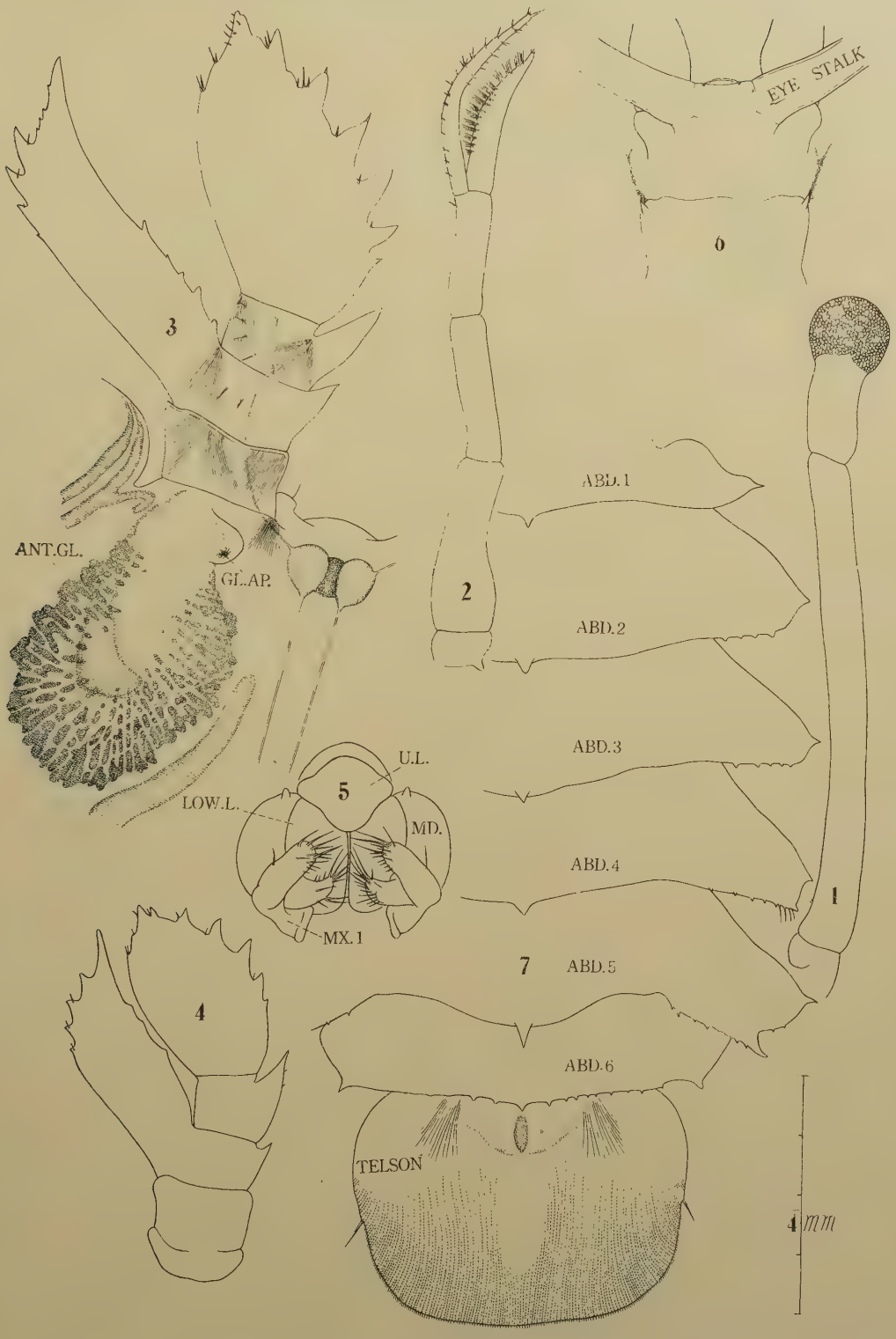
AP. INT. .....Appendix interna
EXP. .....Exopodite

Plate XLIII

Phyllosoma utivaébi nov.

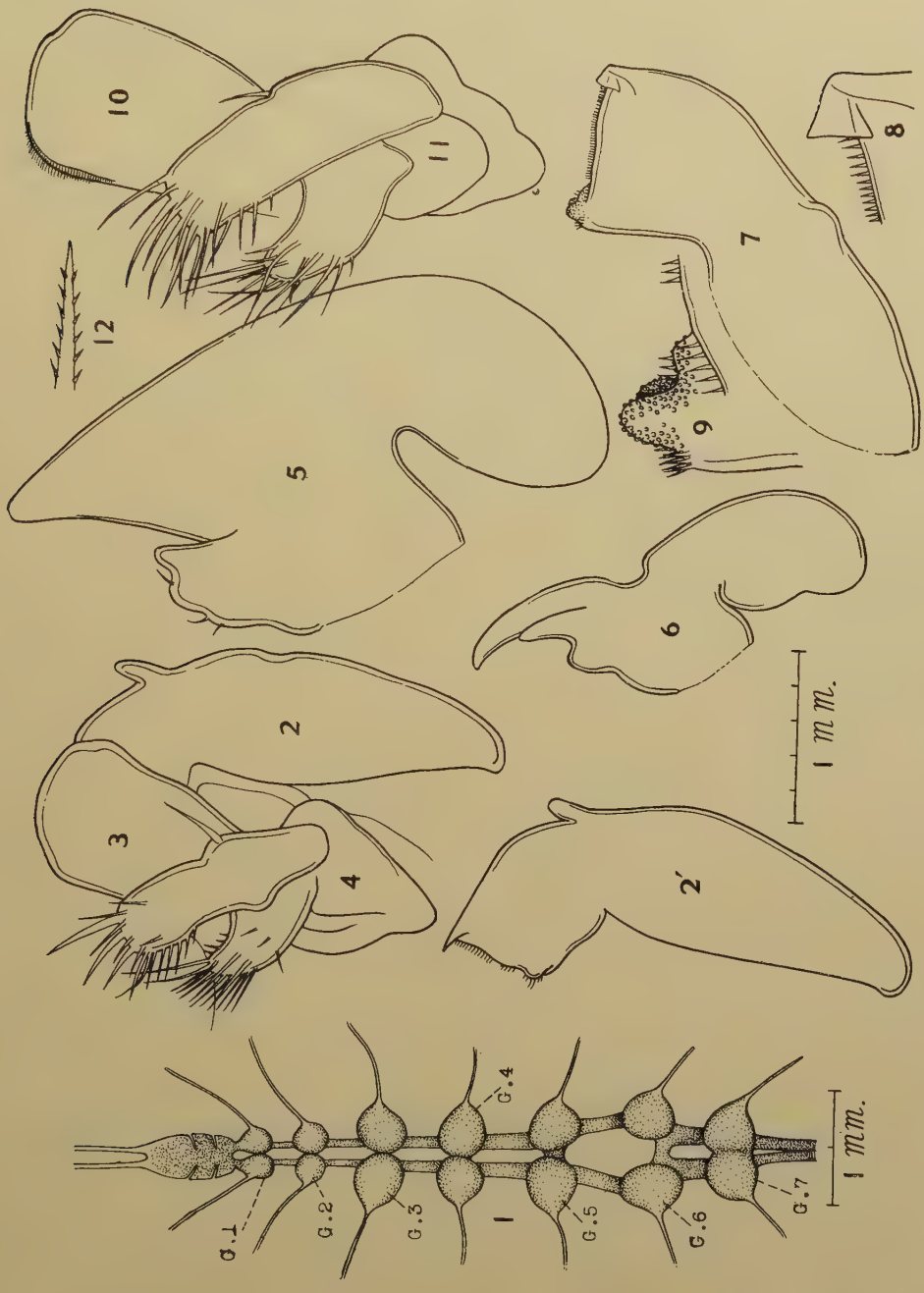
Fig. 1. Specimen No. 1.
Figs. 2–7. Specimen No. 3.
Figs. 8–12. Specimen No. 2.

Fig. 1. Thoracic ganglions, G. 1 (2nd thoracic ganglion)–G. 7 (8th thoracic ganglion).
Figs. 2, 2′. Mandible.
Fig. 3. Lower lip.
Fig. 4. Maxillula.
Fig. 5. Maxilla.
Fig. 6. 1st Maxilliped.
Fig. 7. Mandible.
Fig. 8. Anterior end of blade edge of mandible, magnified.
Fig. 9. Posterior end of blade edge of mandible, magnified.
Fig. 10. Lower lip.
Fig. 11. Maxillula.
Fig. 12. A seta from maxillula, highly magnified.



T. Tokioka: Droplets from the Plankton Net, XIV.

T. Tokioka: Droplets from the Plankton Net, XIV.



T. Tokioka: Droplets from the Plankton Net, XIV.

DROPLETS FROM THE PLANKTON NET[1)]

YATA HANEDA AND TAKASI TOKIOKA

XV. Record of a Caudate Form of *Pegea confoederata* from the Japanese Waters, with Some Notes on its Luminescence.

(Figs. 16, 17)

The senior author had a chance to observe and collect luminous animals caught in the flying-fish nets on a fishing boat in the waters off Suéyosi-Mura of Hatizyô-zima in a night of the spring fishing season, namely on April 25, 1953. Mingled with many luminous animals, *Pyrosoma*, mysids, *Euprymna*, *Beroë*, *Cestus* and siphonophores etc., a considerable number of aggregated forms of two species of salpa were discovered; they were identified by the junior author as *Thetys vagina* (TILESIUS) and *Pegea confoederata bicaudata* (QUOY et GAIMARD). The luminescence was ascertained on more than ten individuals of each salpa, although it could not be observed on weakened individuals kept in a bucket in the dark-room in the laboratory the next day. The luminescence was induceable only by strong stimuli, cutting or tearing of the body, and confined to only a small part of the body, which was about 10 mm long in *Thetys* and ca. 5 mm long in *Pegea*, both rather elongate than round in shape. The light was bluish white in colour, continued one or two minutes and could be repeated again by stimulus. These observations seem to prove that the luminescence in these salpas occurs probably in small luminous organs, but not caused by luminous bacterias or by the luminous secretion which is seen in cases of *Plocamopherus tilesii* BERGH or *Cypridina hilgendorfii* G. W. MÜLLER.

Figure 16 shows two individuals of *Pegea confoederata bicaudata*, the left one is 40 mm long, 16 mm wide and with 12 mm long right posterior protuberance and much shorter left protuberance, while the right one is 38 mm long and 15 mm wide and bears two short protuberances. Examining these specimens, the junior author found a pair of short, 1/4–1/5 of the length of endostyle, longitudinal crests situated one at each side of the endostyle roughly on the level of the ciliated groove. The

1) Contributions from the Seto Marine Biological Laboratory, No. 227.

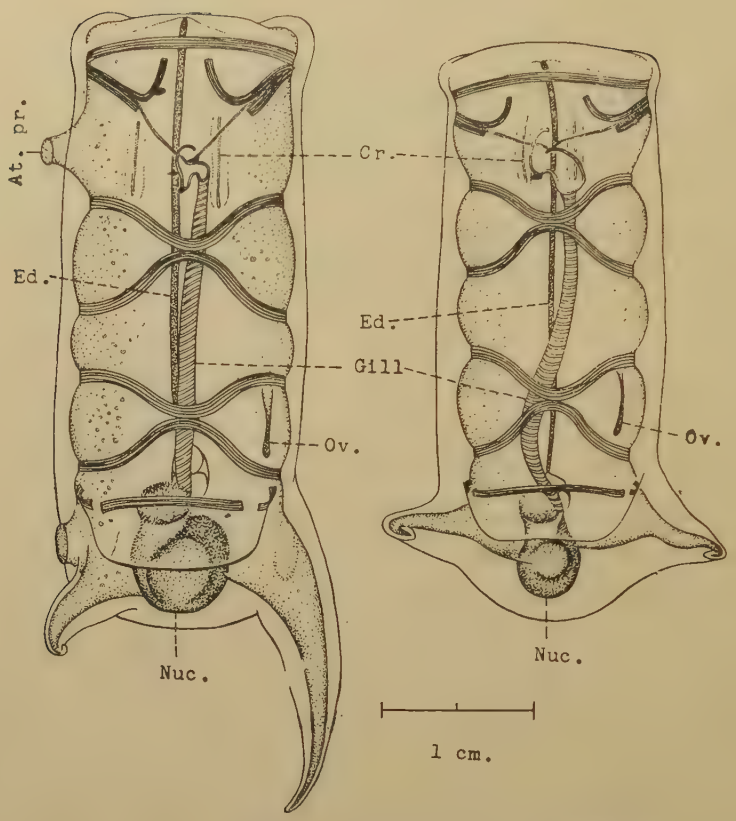


Fig. 16. *Pegea confoederata bicaudata* (QUOY et GAIMARD). Two aggregated individuals, dorsal. At. pr.—attachment process, Cr.—crest-like organ, Ed.—endostyle, Nuc.—nucleus, Ov.— ovary.

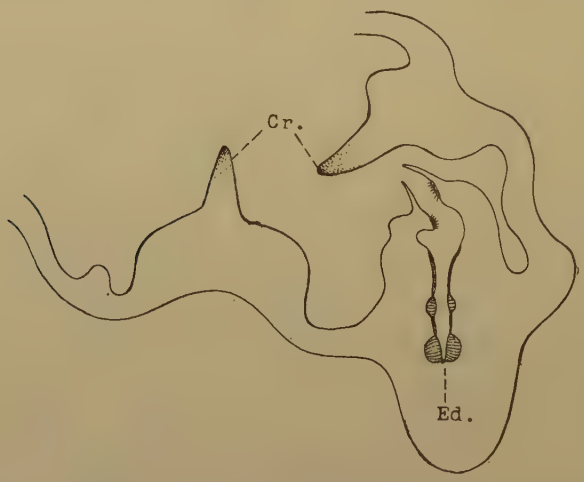


Fig. 17. *Pegea confoederata bicaudata* (QUOY et GAIMARD). Cross section of endostyle and crest-like organs, ×25.

cross section (Fig. 17) shows that many minute corpuscular bodies are densely aggregated along this crest. The present authors consulted with each other about the possibility of the luminescence of these crest-like organs, but could not prove the matter. The light occurred in this salpa was elongate in form as mentioned above, but it was quite uncertain whether the light consisted of a single line or double lines.

Pegea confoederata is not a rare salpa in the Japanese waters, it is already described as luminous. It is considered, however, to be worthy to record that the caudate form, *P. c. bicaudata*, occurs in the Japanese waters and it has a pair of crest-like organs occurring constantly along the endostyle in the aggregated form.

RUNCINA SETOENSIS, A NEW AND RARE SPECIES FROM THE COAST OF KII, MIDDLE JAPAN (OPISTHOBRANCHIA)[1)]

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With one Text-figure

The genus *Runcina* (=*Pelta*) is a small group of the opisthobranchiate Order Cephalaspidea. The animals are mostly very small in size, too. The first record of the genus from our territory was made by me in 1937 (*Runcina elioti* BABA, from Amakusa). The present paper deals with the second form for which I am here going to give a new specific name. I am very glad to thank Dr. Huzio UTINOMI, of the Seto Marine Biological Laboratory, for the kindness shown to me in studying this rare and interesting species at Seto.

Runcina setoensis BABA n. sp.
Kurohime-umiushi (new name)

(Fig. 1)

Animal limaciform, elongate, 3–7 mm in length, the foot projecting behind the mantle, no oral tentacles. Entirely smooth above. Head shallowly bilobed in front, with sessile eyes shining through the skin; the haliotiform shell wholly concealed in the posterior part of the mantle, whitish and much reduced. Anus behind the end of the mantle, median in position; a gill consisting of about 4 lamellae just to the right of the anus. General colour blackish, darker towards the median part, the back sprinkled everywhere with minute brown spots. A submarginal band of ashy yellow running round the mantle excepting at the fore end of the head. Foot sole dirty yellowish covered with minute brown spots as above. Gill blackish. Jaw-plates paired, their surface closely beset with rod-like elements. Radula formula (?). The radulae in my specimens always showed marked tendency of degeneration and were very difficult to count the numbers of the elements composing them. Gizzard as usual armed with 4 chitinous plates.

1) Contributions from the Seto Marine Biological Laboratory, No. 228.

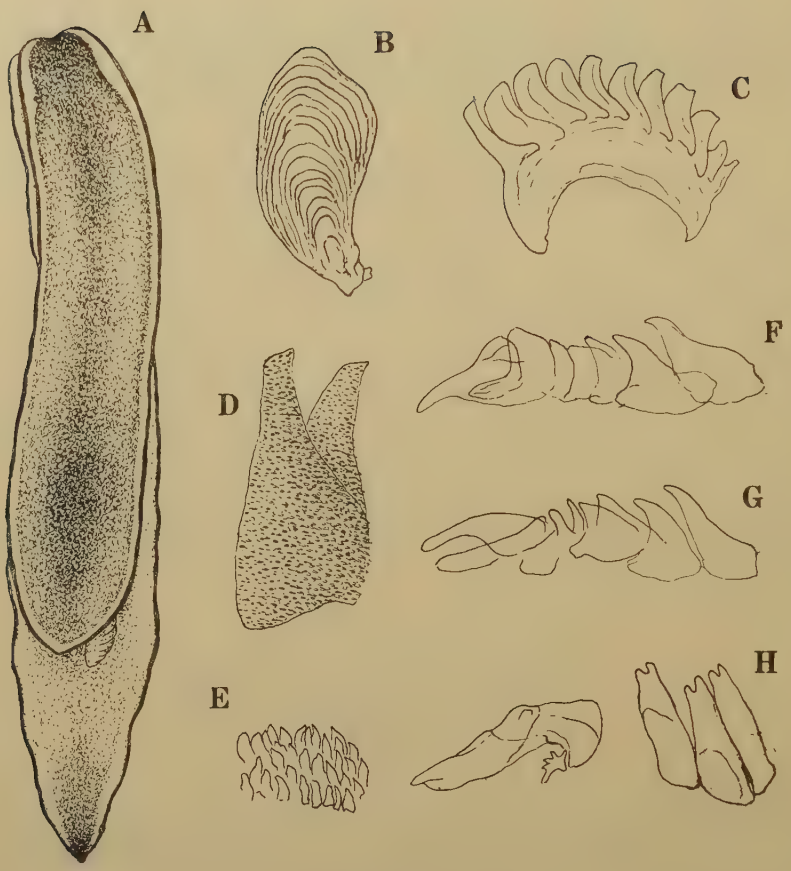

Fig. 1. *Runcina setoensis* n. sp.

A. Animal (Seto, Jan. 4, 1951. Total length 5 mm); B. Shell (×110); C. Chitinous plate of gizzard (×150); D. Jaw-plates (×300); E. Elements of jaw-plate (×600); F-H. All of the radula teeth in 3 different specimens (×600).

Loc.: Seto, Kii, underneath the pebbles in the tide pools of high water level (Jan. and Mar. 1951; Jan. and Apr. 1953; only 12 sps., coll. by Mr. Iwao HAMATANI and the present writer).

The present new species is distinct in colours and in having much reduced radula teeth.

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PARASITIC COPEPODS FROM FISHES OF CELEBES AND BORNEO

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Zoological Institute, Kyoto University, Kyoto

With Plates XLIV–XLIX (1–6)

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ERGASILIDAE

1. *Ergasilus borneoensis* n. sp.

(Pl. I, Figs. 1–7)

Habitat and locality. Gill of unknown fish, probably of the Coridae; Bandjermasin, Borneo.
Material. Some ten gravid females.

Female. Body 0.9–1.1 mm long. Head cordate, 0.35–0.38 mm long by 0.38–0.46 mm broad, with a pair of eye-spots, truncated conical in front, well constricted off from first thoracic segment, with which it forms a violin-body 0.55–0.65 mm long.

First thoracic segment as wide as head but a little shorter, truncated or somewhat concave at posterior margin. Second to fourth thoracic segments diminishing regularly in breadth; second and third segments produced backwards into a small rounded lobe at each dorsal posterior corner. Posterior margin of fourth segment almost squarely truncated, covering anterior part of fifth segment. Aprons of second, third and fourth segments fringed with short denticular spines. Genital segment quadrate, 90–100×100–120μ, without spines on ventral side except along posterior margin which is provided with fine comb-teeth. Abdomen 75–90×65–90μ, consisting of three segments of nearly the same length, each of which bears a row of minute spines along the ventral posterior margin. Caudal rami oblong, two-thirds the length of the last two abdominal segments combined, 27–33×21–30μ, with four setae of different length at distal end. Egg strings cylindrical, 0.97–1.0 mm long by 0.1–0.13 mm broad.

Appendages. First antenna about 0.15 mm long, consisting of 6 segments of nearly the same length, with 3 setae at tip. Second antenna 5–segmented, very long; two distal segments presenting very fine dotted appearance due to striations at right angles to the surface, measuring respectively 0.27 mm and 0.16 mm on convex margin in the type. Mandible with two finely pectinated palps and two chitinous processes (terminal and subterminal), each of which bears on one side a row of acicular spines. First maxilla with two setae. Second maxilla covered with spines except on posterior margin. Maxilliped lacking. Rami of first to fourth legs 3–segmented except fourth exopod which is 2–segmented. They are armed with spines and setae as follows:

First exopod 1–0, 0–1, 2–5; endopod 0–1, 0–1, 2–4.

Second exopod 1–0, 0–1, 0–6; endopod 0–1, 0–2, 0–5.

Third exopod 1–0, 0–1, 0–6; endopod 0–1, 0–2, 0–5.

Fourth exopod 1–0, 1–5; endopod 0–1, 0–2, 0–4.

Fifth leg uniramose, cylindrical, 2–segmented, with one seta on very short basal segment and two setae on terminal segment.

This species resembles *Ergasilus nodosus* WILSON, 1928 and *E. osmeri* VAN BENEDEN, 1870, in possessing a very long second antenna and in the head being well constricted off from the first thoracic segment, but differs from WILSON's species in the possession of fifth legs, in the fourth thoracic segment being neither semicircular nor entirely concealing the fifth segment, in the structure of the mandible, in the armature of the legs, etc., and from VAN BENEDEN's species chiefly in the shape of the head. Since no description is given for BENEDEN's species and the original figure leaves much to be desired, a satisfactory comparison is unable to make.

Taeniacanthidae

2. *Taeniacanthus upenei* n. sp.

(Pl. I, Figs. 8–10; Pl. III, Fig. 20)

Habitat and locality. Gill of *Upeneus* sp.; Macassar, Celebes.
Material. About a dozen gravid females. Male unknown.

Female. Body length 0.65–0.74 mm. Cephlothorax subcordate, 0.27–0.31 mm long by 0.32–0.38 mm broad with prominent frontal cone, whose apex is rounded and may project but slightly beyond the bases of the first antennae. First thoracic segment fused completely with head. Second to fourth thoracic segments diminishing regularly in size posteriorly, measuring in the type 0.1×0.27 mm, 0.084×0.24 mm and 0.042×0.17 mm respectively. Genital segment quadrate, 0.066×0.11 mm, forming together with the abdomen a backwardly tapered cylinder. Abdomen 4–segmented; first to fourth segments diminishing in width posteriorly (96μ, 80μ, 66μ and 53μ respectively in the type), but the third is the shortest of all as shown in the measurements of the type: 40μ, 30μ, 18μ, 27μ. Caudal rami $24 \times 42\mu$ in the type, with the sides in line with those of the abdomen, armed with setae as usual (one seta on outer margin, another on mediodorsal side, and four at tip). Egg sac cigar-shaped, $0.36–0.4 \times 0.1–0.11$ mm, eggs in few longitudinal rows of about a dozen each.

Appendages. First antenna 5–segmented, first to third segments with a continuous row of plumose setae on ventral side, (12 on the first segment except one which is slightly out of the row and an oblique row of 3 smaller setae near the distal end, 6 on the second, 3 on the third); fourth segment with a seta on posterior margin and two ventroterminally, fifth with 7 setae. On the anterior margin of the first antenna there are only 4 setae, 3 on the first segment and one on the second. Second antenna 2–segmented; proximal segment longer than the distal, which bears three simple and two pectinate claws; comb extending along the posterior border of the terminal segment for its greater part. Maxillary hook falciform, pointed. Mandible with a small pointed accessory at base of terminal blade. First maxilla nodular, with 4 whip-like setae of different length. Second maxilla terminating in a very small spiniform palp. Maxilliped reduced to a blunt conical process bearing a tuft of three backwardly directed setae at inner end of its base. Between the second maxillae and the maxillipeds there is seen a stout chitinous bar denticulated along its anterior border, with a small elliptical chitinous knob just in front of its outer end. Behind this bar lie in the median line two inverted V–shaped chitinous structures one behind the other (Fig. 20); the posterior one is followed by another elongated V–shaped chitinous structure, thus forming a rhomb, the posterior end of which is enlarged laterally and extends as far backward as the base of the first pair of legs.

Exopod of first leg 2-segmented; distal segment with one setiform spine and 6 plumose setae along its free margin; proximal segment with a plumose seta at outer corner; endopod with 2 setiform spines and 8 marginal setae. Rami of second to fourth legs 3-segmented, armed with spines and setae as follows:

Second exopod 1-0, 1-1, 2-6; endopod 0-1, 0-2, 3-3.

Third exopod 1-0, 1-1, 2-6; endopod 0-1, 0-2, 3-2.

Fourth exopod 1-0, 1-1, 2-6; endopod 0-1, 0-1, 2-2.

The spines on all the exopods of the second to fourth legs look like setae, so that they may well be looked upon as such. Fifth leg uniramose, 2-segmented; basal segment short, with one seta dorsally, terminal segment about 60μ long by 42μ broad, with three setae distally besides a setiform spine and a comb of stiff hairs on inner margin.

This species differs from the most closely related *Taeniacanthus neopercis* YAMAGUTI, 1939, in the body size, the structure of the maxilliped, the armature of the swimming legs, etc.

3 *Taeniacanthus upenei upeneoides* n. subsp.

(Pl. II, Figs. 17–18)

Habitat and locality. Gill of *Upeneoides bensasi* (TEMM. et SCHLEG.); Macassar, Celebes.
Material. Two gravid females, male unknown.

Female. Body length 0.65–0.75 mm, cephalothorax subcordate, 0.27–0.3 mm long by 0.28–0.33 mm broad, with flattened frontal cone, whose anterior margin in the same convex line as that of first antenna. First thoracic segment fused completely with head. Second to fourth segment decreasing regularly in length and breadth. Genital segment quadrate, 60×100μ, forming with abdomen a slightly telescoping cylinder. Abdomen 120μ long, 4-segmented; first to fourth segments of type measuring 33×84μ, 27×75μ, 18×66μ and 30×60μ respectively, third segment being the shortest of all. Caudal rami 24×24μ, each with 6 setae (one on dorsolateral margin, another on mediodorsal side, and four at tip). Egg sac plump, 0.36×0.15 mm, eggs (except the terminal) arranged in 4 longitudinal rows of 8 each.

Appendages. First antenna 5-segmented; first to third segments with a continuous row of plumose setae (13 on the first, 6 on the second, 1 on the third). Besides these there are an oblique row of 3 setae on the ventral side of the first segment near its distal end and two on the anterior border of the same segment, a similar one at the middle of the anterior margin of the second segment, another at the posterior distal corner of the third segment. Fourth segment with a seta on posterior margin and two close together ventroterminally, fifth with 7 setae. Second

antenna 2-segmented, distal segment a little shorter than the proximal, with 3 simple and 2 pectinate claws, one of which does not curve at the tip like the other, with the comb extending along the posterior border of the terminal segment, and a double row of teeth at its proximal end. Maxillary hook falciform, 130–135μ long. Mandible with a small pointed accessory alongside terminal blade. First maxilla nodular, with 3 setae of different length. Second maxilla with a minute spiniform palp at base of its pectinate terminal blade. Maxilliped reduced to a blunt conical process, with a minute on inner margin near its apex and a tuft of two backwardly directed setae at inner end of its base. Between the second maxillae and the maxillipeds there is a chitinous bar finely denticulated along its anterior border, with a small chitinous knob just in front of its outer end. Behind this bar is seen a chitinous structure as shown in Pl. II, Fig. 17.

Exopod of first leg with 8 plumose marginal setae, one of which is rudimentary and another is devoid of hairs on the inner side; endopod with 8 plumose setae on terminal segment, two on the middle segment, and one on the basal segment. Rami of second to fourth legs 3-segmented, armed with spines and setae as follows:

Second exopod 1–0, 1–1, 2–6; endopod 0–1, 0–2, 3–3.

Third exopod 1–0, 1–1, 2–6; endopod 0–1, 0–2, 2–3.

Fourth exopod 1–0, 1–1, 2–6; endopod 0–1, 0–1, 2–2.

The spines on all the exopods of the above legs are small and bear rudimentary hairs, so that they may well be regarded as setae, while those on the endopods are typical. Fifth leg uniramose, 2-segmented; basal segment with one seta dorsolaterally, terminal segment rounded or spatulate, 42μ wide, with 3 setae and one setiform spine distally.

This subspecies resembles *Taeniacanthus upenei* so closely that a very careful comparison is needed. The most remarkable differences are found in the chitinous median structure on the ventral surface of the cephalothorax in front of the base of the first pair of legs in the shape of the terminal segment of the fifth leg and in the absence of stiff hairs on the inner margin of this segment.

There are some other differences in the armature of the legs, especially of the first leg.

4. *Caligus alalongae* (KRÖYER, 1863)

(Pl. II, Fig. 19; Pl. III, Fig. 21)

Habitat and locality. Gill of *Elagatis* sp. and *Caranx* sp.; Macassar, Celebes.
Material. 5 females and 5 males, all mature.

Female. Body length 2.65–3.2 mm. Carapace 1.3–1.45 mm in length, 1.3–1.45 mm

in width excluding marginal membrane, with rounded sides and distinct frontal plate, truncated behind; medial lobe more than a third of width of carapace, with its lateral corners in close contact with, or overlapping, inner processes of lateral lobes, forming complete oval sinus between. Lunules 0.13–0.15 mm in diameter, 0.27–0.34 mm apart from each other. Free thoracic segment 0.25–0.3 mm in length. Genital segment 0.96–1.33 mm in length (including its anterior portion which is well constricted off), 0.72–1.0 mm wide, produced backwards into distinct lobes on either side of base of abdomen. Abdomen 0.25–0.27×0.28–0.4 mm. Caudal rami small, attached to abdomen subterminally on its ventral side, with 5 setae, three of which are terminal, one is at the posteromedial corner and another at the posterolateral corner. Egg strings about 1.3 mm long, containing 16 eggs.

Appendages of female. First antenna 2-segmented; proximal segment beset along its anteroventral margin with two rows of plumose setae; distal segment rod-shaped, tipped with 11 minute setae. Second antenna with long, simple, terminal claw. Mandible with about a dozen comb-like teeth. Maxillary hook provided at base with a pointed tooth-like accessory spine along with two minute papillae bearing extremely fine setae. Maxilla bifurcate, the anterior ramus much smaller; basal semicircular, chitinous plate with a nodular process on the convex side and another on the flat side, just in front of which and behind the double maxillary palp lies a small, elliptical, transversely striated pad simulating a sucker. Distal segment of first maxilliped with an auricular fold, its terminal claws with a narrow lateral flange, which is smooth in the larger claw but pectinate in the smaller claw. Basal segment of second maxilliped with two small shelf-like projections on inner side as pointed out by KIRTISINGHE, terminal claw with a setiform spine on inner side. Furca with two pointed prongs which are covered on the outer side with an extremely finely corrugated cuticle, and the distal portions of which are parallel or even slightly convergent to each other.

Of the three terminal spines of the first leg the outer one is simple but the other two bear each a small accessory spine at the claw-like tip. On the inner margin there are four setae, of which the distal one is simple and rather spine-like, but the other three are plumose. Basipod and middle segment as described by KIRTISINGHE. Second leg biramous, both rami three-segmented, armed with spines and setae as follows: Exopod 1–1, 1–1, 1–7; endopod 0–1, 0–2, 0–6. The confluent basal plate of third legs 0.72–0.93 mm wide, covering bases of fourth legs on their ventral side, provided on the ventral side near the median line with an anterior group of 9 to 12 small pointed teeth and a stronger posterior chitinous tooth bifurcated to the base, and from the base of the marginal hook toward the posterior sinus of the cephalothorax extends an oblique row of 14 to 20 minute pointed teeth.

Marginal hook at the base of the exopod of the third leg with a very narrow flange at its distal portion. Between this hook and the base of the endopod extends an apron-like membrane attached to the margin of the basal plate of the third leg and fringed with hairs along its emarginate free margin. Exopod of third leg not jointed, though two slight constrictions suggestive of segmentation may be recognizable, with four simple setae and five plumose setae, endopod distinctly two-segmented, proximal segment with one long plumose seta, distal segment with 6 plumose setae diminishing in size outwards. Fourth leg 4-segmented; of the three terminal spines two are pectinate like that of the second or the third segment, but the other is smooth. Fifth leg represented by a minute seta with a papilliform base; sixth leg represented by a tuft of three similar setae, two of which have a common papilliform base. Both pairs of legs are a little medial to the posterior lateral margin of the genital segment just in front of the point where the egg strings are attached.

Male. Body length 1.5–2.2 mm. Carapace 1.1–1.38×1.07–1.38 mm, lunules 0.12–0.16 mm in diameter, 0.25–0.3 mm apart from each other. Free thoracic segment 0.175–0.25×0.26–0.3 mm, with a small nodular projection on each side just behind the larger lateral prominence, on the ventral side of which the fourth leg arises. Between this projection and the genital ovate or flask-shaped, 0.37–0.46×0.3–0.44 mm, only slightly notched on lateral margin immediately behind sixth leg, separated from abdomen by a distinct notch on lateral margin immediately behind sixth leg, separated from abdomen by a distinct notch on lateral margin; posterior margin widely incised at the center on the dorsal side, but divided on the ventral side into two symmetrical lobes separated by a distance of 30–60μ. Abdomen with convex or sloping sides, 0.11–0.16 mm long on lateral margin, 0.2–0.325 mm in maximum width. Caudal rami attached to abdomen terminally, armed as in female, though the seta at the posteromedial corner is much smaller and inconspicuous.

Appendages of male. Like those of female except that the second antenna has a shorter terminal claw and that each posterolateral corner of the genital segment bears two minute setae close together representing the rudiment of the seventh leg.

The account given above agrees well in essential particulars with KIRTISINGHE's description based on the material from Ceylon.

5. *Caligus grandiabdominalis* n. sp.

(Pl. III, Figs. 22–25)

Habitat and locality. Gill of *Caesio kuning* (CUV. et VALENC.); Macassar, Celebes.
Material. Two mature females only.

Female. Body length 2.2–2.32 mm. Carapace rounded, 0.68–0.75×0.75–0.8 mm,

with very prominent frontal plate; medial lobe much more than half the width of the carapace with arcuate posterior margin; posterior sinus gaping; lateral lobes comparatively small, with lateral borders turned over ventrally, pointed posteriorly, projecting as far back as medial lobe. Lunules about 0.1 mm in diameter, 0.09–1.0 mm apart from each other. Free thoracic segment short, strongly constricted at both ends, 0.23–0.25 mm wide, covered dorsally by genital segment for half its length. Genital segment rounded quadrangular, 0.67–0.75×0.94–0.97 mm, with a more or less conspicuous notch at middle of anterior border, lateral margin produced backwards into a rounded lobe, posterior end depressed toward the middle, to which the unusually large abdomen is attached by a short neck. Abdomen one-segmented but clearly divided into two portions; anterior portion flattened peach-shaped, 0.6–0.7×0.7–0.84 mm, with narrow sinus between itself and genital segment, posterior corners rounded; posterior portion quadrate, 0.1–0.125×0.225 mm. Caudal rami small, approximately quadrate, each with 3 spiniform setae at posterior end and two much smaller setae at posterolateral corner. Egg sac plump, 0.55–0.6×0.25–0.26 mm, containing 8–9 eggs, attached to ventral side of genital segment close to posterior end nearer to median line than to lateral borders.

Appendages. Basal segment of first antenna 108–111μ long by 57–60μ wide, beset ventrally with over 20 plumose setae; terminal segment rod-shaped, 90–96μ long by 20–24μ wide, with 1 subterminal and 11 terminal setae. Second antenna weakly developed; terminal claw bent at right angles near its tip. Maxillary hook consisting of a simple, lightly curved, backwardly pointing spine. Maxilla forming a small, simple, broad-based rod; maxillary palp terminating in a single seta. Mandible with about a dozen minute teeth. First maxilliped with wing-like fold near the base of terminal claws, both of which are pectinate. Basal segment of second maxilliped very stout, terminal claw practically smooth, curved at right angles at about its middle. Furca lacking. Terminal segment of first leg with three setae on inner margin, and one seta and three spines at end, one of the latter simple but the other two bifid at tip as usual. Both rami of second leg 3-segmented, armed with spines and setae as follows: Exopod 1–1, 1–1, 1–6; endopod 0–1, 0–2, 0–6. The middle segment of the endopod bears on the outer margin a row of 10–11 short backwardly pointing spines, whose broad bases are held together by a membrane. The distal end of this outer margin is produced into a prominent cone directed outward and backward. Expanded common base of third legs without special armature; exopod may or may not be 2-segmented, with 6 or 7 setae on distal segment; basal hook with an only slightly curved blade 32–36μ long by 12μ broad. Apron between this hook and the endopod is not emarginate at its free border. Endopod with a long stout seta on proximal segment and 6 setae on distal segment.

The two terminal segments being fused, the fourth leg is 3-segmented, though there are 5 spines as usual at their respective position; the narrow lateral flanges of these spines are not pectinate. On the ventral side of each posterior lobes of the genital segment there are two fine setae representing the fifth and sixth leg respectively, the outer one is single, but the inner one is double and lies only a little more anteriorly.

This species is characterized by the possession of an unusually large abdomen, hence the specific name. It is to be noted that the furca is entirely absent in the species under consideration.

6. *Caligus paxillifer*[1] n. sp.

(Pl. III, Figs. 26–27; Pl. IV, Figs. 28–32)

Habitat and locality. Gill of *Chorinemus moadetta* (CUV. et VALENC.); Macassar, Celebes.
Material. A single mature female.

Female. Body 2.85 mm long. Carapace orbicular, 1.35×1.3 mm, with prominent frontal plate which is deeply incised at the center, Lunules large, 0.21 mm in diameter, 0.2 mm apart from each other. Eye-spots about 0.4 mm from frontal margin. Dorsal chitinous frame-work of carapace H-shaped with divergent arms but not in the shape of a double H as shown by WILSON for *Caligus haemulonis*, to which the present species is most closely related; a pair of acicular chitinous ribs extending from beside eye-spots to lunules. Median lobe of carapace with rounded corners, just half the breadth of carapace at base, reaching about 0.1 mm further back of lateral lobes which have rounded ends; posterior sinus moderately deep. Free thoracic segment 0.15 mm long by 0.37 mm broad, with prominent sides. Genital segment orbicular, 0.8×0.875 mm, with its anterior end somewhat constricted off in form of a ring; abdomen apparently one-segmented, subcylindrical, 0.5×0.275 mm, posterior half distinctly broader than anterior half. A very faint segmentation line is seen on the ventral side between these two portions. Caudal rami 104×78μ, somewhat convergent posteriorly, each with 6 plumose setae, of which the one at the inner corner and the two at the outer corner are much smaller than the others. Eggs about 0.2 mm in diameter; their number as well as length of egg sac unknown.

Appendages. Proximal segment of first antenna about as long as distal segment, with numerous comparatively short plumose setae along anteroventral margin; distal segment cylindrical, 0.12 mm long by 30μ broad, with a dozen setae at tip and another on posterior margin near tip. Second antenna with a stout blunt-pointed spine behind its base; terminal claw bent at right angles. Maxillary hook large, curved at right angles, with an accessory spine on the line connecting its base and

1) The specific name refers to the peg (paxillus) observed on either side of the furca.

that of the maxillary palp nearer to itself. Behind the base of this hook is a minute setiferous papilla similar to those on the base. Maxilla represented by a stout, not acuminate, slightly curved, chitinous process with a triangular base, reaching to tip of proboscis; maxillary palp rod-shaped, tipped with two simple setae, one of which is very fine. Mandible with 12 sharp teeth. First maxilliped with an auricular fold near its terminal claws which have on either side a finely pectinated flange. Distal segment of second maxilliped about half as long as proximal segment, with an accessory setiform spine on concave side as usual. The base of the furca is oval though somewhat pointed in front and measures 90μ by 60μ, enclosing a large elliptical foramen; branches comparatively long (90–96μ), slightly divergent, but their rather blunt tips are gently curved inwards, the space between them being 60μ in width. On either side of the base of the furca there is a small chitinous peg projecting ventrad perpendicularly.

Basal segment of first leg with a stumpy process representing the rudiment of an endopod at distal end of posterior margin, middle segment pectinate along posterior margin; distal segment with a seta and three two-tipped claws of different length at distal end but no setae on inner margin. Rami of second and third legs armed with spines and setae as follows:

Second exopod 1–1, 1–1, 1–7; endopod 0–1, 0–2, 0–6.

Third exopod 1–1, 3–4; endopod 0–1, 0–6.

The outermost seta on the terminal segment of the second exopod is short and has a flange on the inner side, and the next one is a little longer and plumose on the inner side only, while the others are all much longer and plumose on both sides. The hook at the base of the third exopod looks as if it were jointed near its base, this terminal portion measuring 54–60μ along the convex margin. Fourth leg made up of three segments; first segment longer than the others combined; second with one terminal spine, third decidedly longer than second, with three spines at distal end and another on posterior margin. The fifth leg, not visible in dorsal view, consists of three minute plumose setae situated close together on the postero-lateral margin of the genital segment; the inner two setae have a common base.

This species is characterized by the absence of setae on the inner margin of the terminal segment of the first leg, by the presence of an accessory spine for the maxillary hook, and the possession of a peg on either side of the furca. It agrees with *C. haemulonis* KRÖYER in general appearance, body size, unsegmented abdomen, absence of plumose setae on the posterior border of the terminal segment of the first leg, and the 3-jointed fourth leg, but differs from it in the frontal plate not projecting so strongly, and in the lunules being separated only by their own diameter.

WILSON says that in *C. haemulonis* the basal joint of the fourth leg is as long as both the others, and the second and third joints are of the same length with all the claws quite close together, and illustrated the base of the furca in his Plate-figure 182 as having parallel sides and a truncate end. This is not the case with the present species. Further, no mention is made of the presence of an accessory spine for the maxillary hook ("first maxilla" of WILSON) nor of a peg on either side of the furca.

C. chorinemi KRÖYER is stated, according to WILSON's key, to have a broad acorn-shaped genital segment with fifth legs visible in dorsal view, and a two-jointed abdomen, whose basal joint is three times the terminal.

7. *Caligus annularis* n. sp.

(Pl. IV, Figs. 33–34)

Habitat and locality. Gill of *Otolithes* sp. and *Caranx* sp.; Macassar, Celebes.
Material. 2 mature females.

Female. Body 2.1–2.4 mm long. Carapace orbicular, 0.9–1.0 mm in length, 0.95–1.04 mm in maximum width near posterior end; frontal plate prominent, with a deep median incision; lunules 0.18 mm in diameter, 0.1–0.13 mm apart from each other. Dorsal chitinous framework H-shaped, with divergent arms. A pair of acicular ribs present in cephalic area. Median lobe broadly rounded behind, projecting but little back of laterial lobes, about half as wide as the carapace at its base; posterior sinus triangular; lateral lobes with rounded ends. Free thoracic segment 0.125 mm long, 0.25–0.26 mm broad through fourth legs. Genital segment acorn-shaped, 0.71–0.83 mm long by 0.6–0.74 mm broad, its anterior portion distinctly constricted off as a ring. Abdomen cylindrical, arising from posterodorsal side of genital segment, 0.4–0.45 mm long by 0.2–0.23 mm broad, unsegmented. Caudal rami 66–75×48–60μ, each with 7 setae, of which the three terminal are the longest and the two subterminal are on the outer margin, the other two are rudimentary and lie at the inner posterior corner. Egg sacs 0.25 mm in diameter.

Appendages. Proximal segment of first antenna nearly triangular, about 90μ long by 60μ broad, covered ventrally for its proximal half by the lateral lobe of the frontal plate, which bears dorsally a submarginal row of hairs; distal half well provided with setae; distal segment cylindrical, 70–80μ by 27μ, with 13 setae at tip and another on distal posterior margin. Second antenna 2-segmented; terminal claw curved at right angles, with a fine, setiform, ventral spine near its base. Behind the base of the second antenna is a blunt, not strongly chitinized spine 38–48μ long by 18–21μ broad. Maxillary hook just like terminal claw of second antenna, though

smaller (0.15 mm : 0.1–0.15 mm as measured from base to tip along convex margin), with an accessory spine medial to its base. Maxilla in form of a stout, blunt-pointed process, only slightly curved outward ; palp terminating in two setae, one of which is rudimentary. First and second maxillipeds in the usual form, though the proximal segment of the former is comparatively thick. Furca 105–126μ long from anterior end of its base to tip of branch ; base rounded in front, 54–70μ in diameter ; branches curved inward, with rather blunt tip, 50–66μ long, 70–75μ from side to side. Neither peg nor anything alike on either side of furca. First leg without setae on posterior margin of terminal segment as in *Caligus paxillifer* ; terminal claws 33μ, 27μ and 21μ long respectively. Second and third legs armed with spines and setae as follows :

Second exopod 1–1, 1–1, 1–7 ; endopod 0–1, 0–2, 0–6.

Third exopod 1–1, 3–4 ; endopod 0–1, 0–6.

Basal hook of third leg 2–segmented ; distal segment 30–36μ long. Fourth leg 3-segmented ; first segment as long as second and third segments combined ; second segment 90–100μ long ; third segment 0.1–0.14 mm long, with four spines. Fifth leg invisible in dorsal view, made up of a tuft of three setae, two of which have a common base, situated ventrally near posterolateral corner of genital segment.

This species agrees well with *Caligus paxillifer* in the armature of the swimming legs, but differs from it in the anterior portion of the genital segment being distinctly marked off as a ring, in the genital segment being acorn-shaped instead of being orbicular, in the abdomen being unsegmented, in the absence of a pair of pegs beside the furca, in the shape and size of the furca, etc.

The specific name refers to the ring of the genital segment.

8. *Anuretes plectorhynchi* YAMAGUTI, 1936

Habitat and locality. Gill of *Plectorhynchus* sp. ; Macassar, Celebes.
Material. About a dozen mature females.

Female. Body 1.3–1.7 mm long. Carapace orbicular, 0.95–1.05 mm long by 0.95–1.04 mm wide behind its middle ; thoracic area quadrangular ; median lobe 0.45–0.51 mm wide, a little more, or less than, or equal to, half the breadth of carapace, with its posterior margin level with blunt tips of lateral lobes or slightly further behind, usually in contact with anterior margin of genital segment ; lateral area narrow, frontal plate well defined. Free thoracic segment 0.09–0.15 × 0.15–0.25 mm, not visible from dorsal side unless the body is stretched. Genital segment rounded, 0.41–0.52 × 0.7–0.73 mm. Abdomen fused with genital segment leaving two-lobed anal region free, which lies on the posterodorsal side of the genital segment. Caudal rami stumpy, 20–27μ broad, with 6 setae. Egg sac plump, 0.7–0.95 × 0.22–0.25 mm, containing a

series of 10–20 eggs.

Appendages. Just as described in my paper of 1936.

Anthosomatidae

9. *Lernanthropus corniger* n. sp.

(Pl. IV, Figs. 35–39; Pl. V, Figs. 40–41)

Habitat and locality. Gill of *Megalaspis* sp.; Macassar, Celebes.
Material. A single mature female.

Female. Body oblong, 2.7 mm long. Head ovate, 1.15 mm long by 1.0 mm wide; lateral margins turned ventrally and approaching each other, projecting forward in the form of a sleeve 0.275 mm further anteriorly than frontal margin which is somewhat depressed at the center; posterior margin notched; antennal area with a stout coathanger-shaped chitinous bar about 0.45 mm long. First thoracic segment 0.15×0.475 mm, constricted off from head and second segment, almost entirely concealed in dorsal view. Second segment forming prominent rounded shoulder of the trunk, 0.775 mm in diameter, fused with third segment with a shallow lateral notch indicating the separation of the two segments. Third segment 0.54 mm long by 1.0 mm wide, with convex sides, constricted off from dorsal plate of fourth segment. Latter circular, 0.75×0.91 mm. Fourth segment showing ventrally a distinct ovate plate 0.61 mm long by 0.48 mm wide, with the sides pressed against the third legs. Fifth segment short, without appendages. Genital segment 0.15 mm long, with convex sides, narrowed abruptly behind; abdomen vase-shaped, 0.12 mm long by 144μ wide, entirely concealed in dorsal view. Caudal rami horn-shaped, 0.135–0.15×0.045 mm, somewhat divergent, projecting behind dorsal plate for greater part of their length, each with two minute spiniform setae at distal end and another on lateral margin. Egg strings unknown.

Appendages. First antenna 6-segmented, tapering distally, with few short setae on anterior margin besides one subterminal and several terminal ones. Just in front of the base of each second antenna is seen a simple seta projecting backward and inward from an elevation of the head; it probably represents an antennule. Second antennae 2-segmented, with a pair of V-shaped chitin pieces appressed to each other between their bases; segments presenting fine dots all over except on the comparatively short, longitudinally striated terminal claw as well as on the knob lying opposite the concave side of this claw. On the inner side of the distal segment there is a rudimentary spine with a mamillary base destitute of dots. Between this spine and the knob mentioned above is a marked rise and fall of the margin. Mandible slender,

without teeth. Maxilla divided into two rami; inner ramus nodular, situated immediately beside proboscis, tipped with two spines, outer ramus directed outwards tapering toward distal end with two spines of unequal length, covered on the ventral surface with very fine spines, of which those on the distal half of the ramus are much smaller than those on the proximal half and only discernible with the aid of an oil immersion lens. The longer terminal spine of this ramus shows a slight bending at the middle as if it were jointed; the terminal portion contains a skeletal chitin for its proximal half only, so that the distal half looks like a seta. The same is true with the shorter spine. First maxilliped 3 segmented; basal segment comparatively stout, as long as the remaining or even longer. Middle segment with nine, slightly recurved, dentiform spines on the distal inner surface, and another a little larger one on the distal dorsal side; terminal segment forming a short typical claw which measures about 45μ on its concave margin and carries along each side a row of six spines diminishing in size distally, leaving the point free. Second maxilliped 4-segmented; second segment stouter than first, longer than third and fourth combined, with a minute seta on inner margin opposite terminal claw, covered on ventral side with extremely fine spines scarcely projecting above the surface except those around the seta mentioned above; third segment likewise spined, fourth segment forming a well chitinized powerful claw with a few transverse striations on proximal convex side.

First leg biramose, with a seta medial to its base, concealed beneath second maxilliped; outer ramus carpus-shaped, with a row of 5 spines at distal end, covered with very small spines on outer face; inner ramus rod-shaped, covered with comparatively few spinelets, terminating in a seta which is plumose except for the basal portion. Second leg biramose, with a simple seta lateral to its base; outer ramus spined like that of first leg, but one of the marginal spines (the second one as numbered from outside) lies a little out of the row and appears rudimentary, inner ramus rod-shaped, without seta, a little longer than outer ramus, covered with spinelets. Third legs plicate, entirely separated one from the other, reaching backward to level of bases of fourth legs, showing outer skirt in dorsal view, with inner margin pressed against ventral plate of fourth segment. Fourth legs divergent, each divided under dorsal plate into two rami each tapering to a pointed tip; outer ramus measuring 1.06–1.075 × 0.2 mm, inner one 0.875–0.925 × 0.15–0.175 mm.

This species bears a certain resemblance to *Lernanthropus spiculatus* WILSON, 1913, in general appearance, but differs from it in the head lacking the lateral notch indicating the separation of the antennal area from the rest of the head and possessing more prominent anterior horns, in the dorsal plate of the fourth segment being circular instead of ovate, in the presence of a distinct ventral plate for the fourth thoracic

segment, in the outer skirt of the third legs and the greater part of the caudal rami being visible in dorsal view. As regards the appendages there are marked differences between the two species, especially in the structure of the antennae, of the maxillipeds (WILSON seems to have overlooked the first maxilliped) and of the legs. In WILSON's species the first legs are rudimentary, and the second are reduced to mere knobs, while the third are fused at the base in the midline in strong contrast with those of the present species.

The specific name refers to the horn-like anterior lobes of the head.

10. *Lernanthropus latis* n. sp.

(Pl. V, Figs. 42–48)

Habitat and locality. Gill of *Lates calcarifer* BLOCH; Macassar, Celebes.
Material. 5 males and 12 females, all mature.

Female. Body length (from anterior extremity to tips of caudal rami exclusive of fourth legs) 4.2–4.6 mm. Cephalothorax rounded quadrangular with the greatest breadth behind its middle, 0.7–0.75×0.7–0.8 mm, with an invagination at each antero-lateral corner, just in front of which are seen from the dorsal side the first antenna and the base of the antennule. The first thoracic segment is usually fused with the head, but occasionally constricted from it as well as from the second thoracic segment, measuring 0.18–0.2 mm in length and 0.35–0.4 mm in breadth. Second and third thoracic segments with convex sides, well marked off, measuring 0.5–0.63×0.55–0.82 mm and 0.85–1.05×0.7–1.0 mm respectively. Fourth legs to caudal rami entirely covered up by dorsal plate, which is oval with maximum breadth of 1.3–1.6 mm, and more or less distinctly truncated at the posterior margin, forming a violin-shape together with third thoracic segment. As measured from the posterior end of the third thoracic segment the dorsal plate is 2.1–2.4 mm long. In the type the genital segment bearing the fifth legs is 0.3 mm long and 0.4 mm broad at the level where the egg strings are attached.

Abdomen small, quadrate, with lightly convex sides. Caudal rami horn-shaped, divergent posteriorly, attached to abdomen terminally, 0.15–0.24 mm long, 75–90μ broad at the base which bears two setae dorsally. Egg string 2–4 mm long by 0.2–0.23 mm broad, containing a series of 32–82 discoid eggs. The spermatophore attached to the genital segment behind the egg string is 0.11–0.16 mm long.

Appendages of female. First antenna distinctly 6-segmented, tipped with several minute setae. Second antenna with stout, conical, chitinous tooth about 60μ long and a small, papilliform chitinous projection tipped with a very fine spine on inner

side of basal segment; terminal claw with very fine longitudinal striae on the surface except on the convex side where extremely fine granulations are scattered. Mouth tube tapering distally. Mandible with 6 minute recurved teeth. Maxilla with two setae of unequal length on inner ramus and three (one large and two small) on outer ramus. Terminal claw of first maxilliped beset with extremely fine acicular spines except on convex margin. Basal joint of second maxilliped stout, provided on the proximal ventral margin with two pads of different size and shape which are covered all over with acicular spinelets; the smaller pad lies just lateral to the regular basal seta partly encircling it; the larger lies proximal to the smaller with the narrower end in contact with the latter. Terminal claw of second maxilliped smooth, with an accessory spine at its base. Basipod of first leg covered with acicular hairs on outer side; endopod rod-shaped, beset on ventral side with extremely small spines, tipped with spine a little shorter than itself; exopod palm-shaped, covered ventrally with minute spines, with 5 short spines along its distal margin. Second leg one-jointed; both rami like those of first leg, though the marginal spines of the exopod show a tendency toward atrophy, the medial three being in the form of pointed teeth. Third leg removed far behind the second, extending diagonally outward and backward in form of an auricular lobe. Fourth leg one-jointed, bifurcate, directed backward; stem 0.62–0.85 mm long, both rami cigar-shaped, projecting well beyond posterior margin of dorsal plate, each provided at its tip with a small rounded knob covered with some twenty spines; endopod 1.1–1.5 mm long by 0.23–0.3 mm broad, may be unusually short; exopod 0.8–1.1 mm long by 0.2–0.28 mm broad. Fifth leg reduced to a short simple rod projecting outward and backward with its tip overlapping stem of fourth leg dorsally.

Male. Body length 1.9–2.0 mm. Cephalothorax more rounded in outline than that of female, broader than the rest of the body, 0.55–0.63×0.55–0.6 mm. First thoracic segment completely fused with head. Second thoracic segment 0.22–0.3×0.42–0.5 mm, third segment 0.37–0.4×0.47–0.55 m, fourth segment 0.37–0.5×0.45–0.5 mm, fifth (genital) segment and abdomen tapering rapidly toward caudal end. Caudal rami horn-shaped, divergent, arising just in front of anus, 0.12–0.14 mm long.

Appendages of male. First antenna like that of female. Second antenna with stout conical tooth medially as in female, terminal claw longitudinally striated but not granulated on convex side. Mandible and maxilla like those of female. Terminal claw of first maxilliped with two marginal rows of minute spines. Second maxilliped, first and second legs as in female. Third leg bifurcated to near its base, both rami unequal in length, directed divergently outward and backward, with spiny terminal knob; exopod 0.3–0.5 mm long, endopod 0.15–0.2 mm long. Fourth leg bifurcate, entirely visible in dorsal view; stem 0.35–0.4 mm long, rami flattened cigar-shaped,

varying in length with spiny terminal knob, divergent; exopod 0.37–0.45 mm long, endopod 0.36–0.58 mm long. Fifth leg lacking.

This species differs from the most closely related *Lernanthropus micropterygis* RICHIARDI of WILSON as shown in the following table of comparison.

	L. micropterygis of WILSON	*L. latis*
Body length	3.25 (male) 7.0 (female)	1.9–2.0 (male) 4.2–4.6 (female)
Caudal rami of female	attached to abdomen ventrally, lanceolate	attached to abdomen terminally, horn-like
Egg strings	7 mm long	2–4 mm long
Mandible	four-spined	six-toothed
Fourth leg of both sexes	divided to its base	divided, but not to its base
Fifth leg of female	lanceolate, reaching nearly to posterior margin of dorsal plate	rod-shaped, very short, reaching to dorsal side of stem of fourth leg

11. *Lernanthropus caesionis* n. sp.

(Pl. V, Figs. 49–52)

Habitat and locality. Gill of *Caesio kuning* (CUV. et VALENC.); Macassar, Celebes.
Material. Two mature females.

Female. Body (from anterior end of frontal plate to posterior end of dorsal plate) 3.1–3.3 mm long, enlarged posteriorly. Cephalothorax approximately trapezoid in dorsal view, though convex at posterior margin, 1.05–1.15×0.85–0.98 mm, with a prominent semicircular plate in front and the sides turned over ventrally. First thoracic segment fused completely with head, second thoracic segment fused with third segment to form a shoulder for the latter, which is broader than long with its greatest diameter (0.9–1.25 mm) at base of third legs, well marked off in front as well as behind. Dorsal plate circular, 1.47–1.58×1.65–1.7 mm, covering up entire fourth and fifth thoracic segments, abdomen, caudal rami and folded egg strings. Abdomen shorter and narrower than genital segment, at about center of dorsal plate. Caudal rami arising from ventral side of abdomen near its posterior end, lanceolate, a little longer than wide, with 2 minute hairs at the tip. Egg strings folded up under dorsal plate, about 1.5 mm long, each containing a series of some 40 discoid eggs.

Appendages. First antenna arising from ventral side of front plate near its lateral margin, unsegmented, showing a more or less sharp bending on anterior

margin a little proximal to its middle, whence it tapers rapidly toward the setose tip. Terminal claw of second antenna with longitudinal striations. About midway between the base of the first antenna and that of the second antenna there is a long setiform antennule containing pulp throughout its length. Behind the second antenna lies a blunt-pointed rod-shaped process slightly curved outward and backward. Mandible with 7 small recurved teeth. Inner ramus of maxilla with a single terminal seta, outer ramus tipped with 2 unequal setae. Terminal claw of first maxilliped distinctly pectinate; that of second maxilliped longitudinally striated. Exopod of first leg palm-shaped, with 5 terminal spines, endopod short, rod-shaped, smooth. Exopod of second leg with three short spines and two much smaller ones, endopod small, stumpy, without setae. Third leg laminate, folded, projecting downwards perpendicularly. Fourth leg divided to near its base, both rami markedly attenuated posteriorly, subequal (1.0–1.15×0.21–0.3 mm), the inner slightly longer than the outer with their tips projecting a short distance beyond posterior border of dorsal plate. Fifth leg lacking.

This species differs from *Lernanthropus pristipomodis* KIRTISINGHE, 1937, in general appearance, especially in the dorsal plate being distinctly separated from the foregoing thoracic segment, in the first antennae being unsegmented, and in the fourth leg being much narrower posteriorly and projecting backward but little beyond the dorsal plate.

DICHELESTHIIDAE

12. *Hatschekia teuthidis* n. sp.

(Pl. VI, Figs. 53–55)

Habitat and locality. Gill of *Teuthis* sp.; Maccasar, Celebes.
Material. Three mature females without egg sacs.

Female. Body 0.94–1.05 mm long. Head rounded, 0.13–0.15×0.13–0.19 mm with strongly convex sides and prominent medially notched frontal plate; dorsal chitinous frame consisting of a pair of symmetrical arcuate lateral arms, with a pair of ventrally recurved accessory pieces inside of their anterior half, and a median rib, whose anterior end extending into the frontal plate forms an elliptical ring, and whose posterior end forms a sharp-pointed dagger. A blunt-conical knob is present immediately behind the base of each second antenna, but none on either side of the base of the mouth tube. First thoracic segment forming neck 0.12 mm broad, second fused with genital segment. Latter elongated elliptical, though constricted at middle, 0.69–0.75 mm long by 0.23–0.25 mm broad. Abdomen small, semicircular, with prominent anal region. Caudal rami rod-shaped, 24μ long by 10μ broad, attached to ventral

side of abdomen, with an acicular seta on outer margin and five setae at distal end.

Appendages. First antenna not segmented, about 0.1 mm long, projecting outward a little beyond lateral margin of head, with comparatively few setae on ventral side, tipped with 7 setae, one of which being very fine may be overlooked. Basal segment of second antenna constricted near its distal end; terminal claw comparatively small, strongly recurved. Maxilla represented by a spiniform seta. Mandible slender, without teeth on its small cutting blade. Maxilliped 4-segmented; terminal claw bifid at tip; third segment slender, shorter than second segment. First two pairs of legs biramose; exopod distinctly, endopods indistinctly, 2-segmented. Proximal segment of first exopod with a very minute seta at outer distal end; distal segment of first exopod with one subterminal and three terminal setae in the type, but like that of second exopod in the paratypes. First endopod narrower than second endopod, tipped with one to three setae.[1] Proximal segment of second exopod with a terminal seta a little shorter than distal segment; latter with a very fine seta besides the terminal one; endopod with one subterminal and three terminal setae. Third leg on ventrolateral margin of trunk, 0.55 mm behind second leg, represented by a hair-like seta with a papilliform base. It was found on the right side only in the type, but not in the paratype. Fourth leg lacking.

This species resembles *Hatschekia labracis* (VAN BENEDEN) of mine (1939) very closely, but differs from it in the dorsal chitin-frame of the head, and the appendages, especially in the first antenna being unsegmented, in the maxilla consisting of one seta and one spine without being divided into 2 setiferous lobes, and in the swimming legs being more poorly developed.

13. *Hatschekia synagris* n. sp.

(Pl. VI, Figs. 56-58)

Habitat and locality. Gill of *Synagris taeniopterus* (VALENC.); Macassar, Celebes.
Material. Two mature females with egg sacs detached.

Female. Body 1.0–1.025 mm long. Head nearly quadrangular, though semicircular or broadly rounded at posterior margin, 0.22–0.23 mm long by 0.21–0.23 mm broad; frontal plate cordate, 2-lobed, with median notch. Dorsal chitinous framework consisting of a very strong transverse bar and a median rib, the anterior end of which is expanded into a triangular plate and lies in the frontal plate with the flat basis in front. On either side of the head just behind the second antenna there are

1) Even in the same individual the number of the setae is different on the right and left. In the type the right endopod terminates in a relatively strong seta, the left one however bears three small setae.

close together two short horn-like processes with their tips directed outward. At this level the head attains its maximum diameter. First thoracic segment constricted off from head and covered up dorsally by its posterior lobe. Second thoracic segment fused with genital segment. Latter elliptical, 0.65–0.68×0.25–0.325 mm. Abdomen small, inverted trapezoid, 42×60μ in the type. Caudal rami rod-shaped, 33–36×13–15μ, with one seta on dorsolateral margin and three setae at tip.

Appendages. First antenna not segmented, 0.18 mm long, with 16 setae on anterior margin, about a dozen setae at tip. Second antenna stout, with strongly curved claw. Maxilla divided to near its base into two setae of unequal length, of which the inner one is a little longer. Mandible in form of a slender cutting knife. Maxilliped 4-segmented; third segment slender, just as long as second segment; terminal claw bifid at tip.

First and second legs biramose; each exopod 2-segmented, endopod of first leg not segmented, but of second leg 2-segmented. Proximal segment of first exopod with a rudimentary seta at outer distal end, distal segment tipped with two setae; endopod with two terminal setae. Proximal segment of second exopod produced backward beyond base of distal segment and bearing a very long seta, distal segment with a minute seta besides the much longer one at tip; endopod tipped with two setae. Third leg lacking, or rudimentary if at all.

This species is characterized by the almost quadrangular shape of the head, the structure of the dorsal chitinous framework, etc. *Hatschekia foliata* REDKAR, RANGNEKAR et MURTI, 1950, from the related *Synagris japonica* is easily distinguished from the present species by its general body shape, especially by the marginal indentations of the genital segment.

14. *Hatschekia longigenitalis* n. sp.

(Pl. VI, Figs. 59–61)

Habitat and locality. Gill of *Synagris taeniopterus* (VALENC.); Macassar, Celebes.
Material. Some ten mature females.

Female. Body slender, 1.0–1.3 mm long. Head rounded, 0.1–0.11 mm long by 0.13–0.17 mm broad, with the sides projecting in form of a hemisphere; frontal margin depressed; posterior margin broadly rounded, overlapping first thoracic segment, with a slight notch between itself and the knob-like side. Dorsal chitinous framework consisting of a median piece and a pair of arcuate lateral arms making altogether a farmer's three-pronged raker withont handle. On the ventral side just anterolateral to each maxilla there is a two-tipped nodular process projecting ventrad. First thoracic segment forming neck at level of base of its legs. Second thoracic segment fused

with genital segment to form a trunk, which is very long and slender, constituting the most outstanding feature of this parasite. Genital segment 0.9–1.128 mm in length, 0.14–0.18 mm in maximum width near its posterior end. Abdomen hemispherical, 15–25μ long by 30–50μ broad, with more or less prominent anal region. Caudal rami rod-shaped, 15–21×6–9μ, with one seta on dorsolateral margin, another subterminally and three more terminally.

Appendages. First antenna not segmented, though the somewhat broader proximal portion bearing a row of 4 setae along its anteroventral margin may be marked off from the rest by an abrupt rise on the anterior margin; provided with comparatively few setae (about 10 along anterior margin, 6 setae at and near tip). Second antennae abruptly enlarged at base, projecting forward close together with their small terminal claws directed ventrad. Maxilla divided into two lobes, each of which bears two setae. Mandible slender, without teeth. Maxilliped 4-segmented, third segment a little shorter than second; terminal claw bifid at tip. First and second legs biramose; exopods of both legs two-segmented, but endopods one-segmented. Proximal segments of both exopods with one seta each, distal segment with three setae for first leg and two for second leg; both endopods with one seta on inner margin and three at tip. Third legs lacking.

This species resembles *Hatschekia pagrosomi* YAMAGUTI, 1939, in the extraordinary length of the genital segment, but differs from it in body size, in the head being much more produced outward, in the endopods of the first two swimming legs being unsegmented, etc.

15. *Hatschekia gracilis* n. sp.

(Pl. VI, Figs. 62–65)

Habitat and locality. Gill of *Lethrinus* sp.; Macassar, Celebes.
Material. Some ten mature females.

Female. Body slender, 1.9–2.1 mm long. Head cordate, 0.175–0.2 mm in length, 0.16–0.19 mm in maximum breadth near posterior margin which is only slightly convex and partly covers the first thoracic segment. Frontal plate prominent, flattened conical or semicircular, projecting a little beyond the bases of first antennae. Dorsal chitinous framework consisting of a pair of symmetrical arcuate lateral arms and a median rib, the anterior end of which extends into the frontal plate and forms a triangle. Each of the two arms is supported near its anterior end by an X-shaped accessory piece, whose ventrally directed stem turns inward at the point where it gives rise to a rudimentary side branch. The median rib as well as the two arms terminates in a sharp point at the level of the broadest part of the head. On the ventral side of the head just behind the base of each second antenna there is a fleshy, not very sharp-

pointed process applied to the antenna. First thoracic segment forming neck only 90μ broad. Genital segment slender, 1.6–1.8 mm in length, 0.18–0.2 mm in maximum breadth at its posterior third. Abdomen semicircular, 18–24μ by 50–63μ. Caudal rami small, 15–18×7–8μ, attached to ventral side of abdomen. Egg sacs cigarette-shaped, 0.62–0.95 mm long, each containing a series of about ten or more eggs.

Appendages. First antenna 84–90μ long, tapering gradually toward distal end, without distinct joints except the basal which occupies almost half the entire length. The marginal setae of the first antenna are very fine and few (only 5 for the basal segment); of the 8 terminal ones five are longer than the others which are minute like the marginal. Stout basal segment of second antenna finely dotted on the surface for the greater part; terminal claw falcate. Maxilla represented by a simple seta. Mandible slender, without teeth. Maxilliped 4-segmented; third segment a little shorter than second segment; terminal claw bifid. First and second legs biramose; exopods 2-segmented but endopods 1-segmented. Proximal segments of first and second exopods with a terminal spine at each distal outer end. Distal segment of first exopod with 5 setae, of which two are at the tip, and the other three along distal inner margin; first endopod with 5 setae including the one at middle of inner margin. Second exopod with three terminal setae; second endopod with two setae on inner margin and four at tip. Third legs absent.

This species differs from the most closely related *H. longigenitalis* (*vide supra*) chiefly in body size, the shape of the head and the structure of its chitinous framework, in the second antennae being dotted for the greater part and in the maxilla being a simple seta.

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EXPLANATION OF PLATES

Plate I

Figs. 1–7. Female of *Ergasilus borneoensis* n. sp.
Fig. 1. Dorsal view of gravid female. Fig. 2. Mouth parts.
Fig. 3. First leg. Fig. 4. Second leg.
Fig. 5. Third leg. Fig. 6. Fourth leg.
Fig. 7. Fifth leg.
Figs. 8–10. Female of *Taeniacanthus upenei* n. sp.
Fig. 8. Dorsal view of gravid female. Fig. 9. Mouth parts.
Fig. 10. Fifth leg.

Plate II

Figs. 11–16. Female of *Taeniacanthus upenei* n. sp.
Fig. 11. Posterior extremity. Fig. 12. Antenna and maxillary hook.
Fig. 13. First leg. Fig. 14. Second leg.
Fig. 15. Third leg. Fig. 16. Fourth leg.
Figs. 17–18. Female of *Taeniacanthus upenei upeneoides* n. subsp.
Fig. 17. Chitinous median structure on ventral side of cephalothorax in front of base of first legs. Fig. 18. Fifth leg.
Fig. 19. Mature male of *Caligus alalongae* (Kröyer, 1863).

Plate III

Fig. 20. Chitinous median structure on ventral side of cephalothorax in front of base of first legs in female of *Taeniacanthus upenei* n. sp.
Fig. 21. Gravid female of *Caligus alalongae* (Kröyer, 1863)
Figs. 22–25. Female of *Caligus grandiabdominalis* n. sp.
Fig. 22. Dorsal view of mature female. Fig. 23. Second leg.
Fig. 24. Third leg. Fig. 25. Fourth leg.
Figs. 26–27 Female of *Caligus paxillifer* n. sp.
Fig. 26. Dorsal view of a mature female. Fig. 27. First leg.

Plate IV

Figs. 28–32. Female of *Caligus paxillifer* n. sp.
Fig. 28. Maxillary hook. Fig. 29. Furca.
Fig. 30. Second leg. Fig. 31. Third leg.
Fig. 32. Fourth leg.
Figs. 33–34. Female of *Caligus annularis* n. sp.
Fig. 33. Dorsal view of mature female. Fig. 34. Furca.

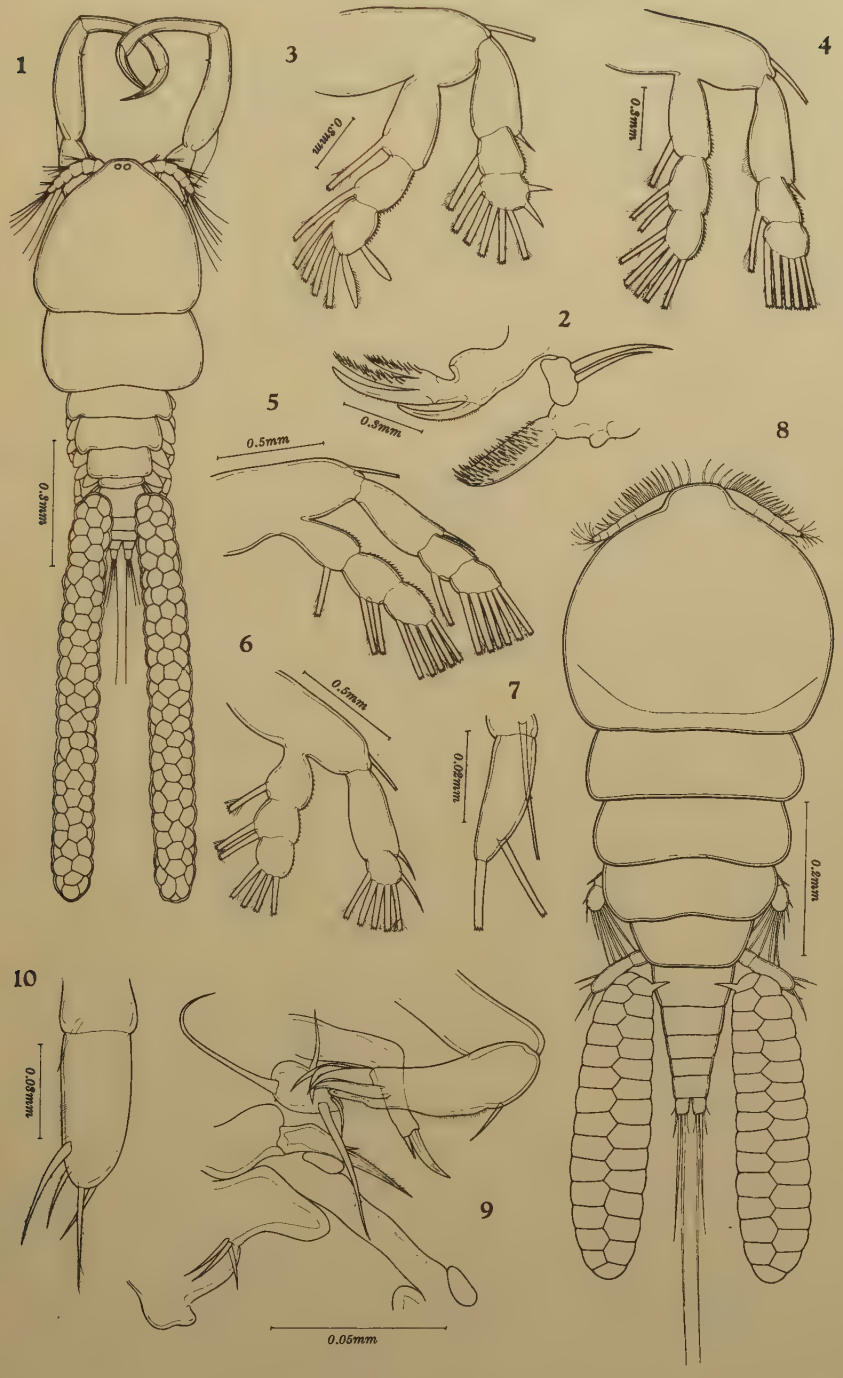
Figs. 35–39. Female of *Lernanthropus corniger* n. sp.
Fig. 35. Dorsal view of mature female. Fig. 36. Second antenna.
Fig. 37. Maxilla. Fig. 38. First maxilliped.
Fig. 39. Second maxilliped.

PLATE V

Figs. 40–41. Female of *Lernanthropus corniger* n. sp.
Fig. 40. First leg. Fig. 41. Second leg.
Figs. 42–46. Female of *Lernanthropus latis* n. sp.
Fig. 42. Dorsal view of gravid female.
Fig. 43. Ventral view of posterior extremity.
Fig. 44. Second antenna. Fig. 45. First leg.
Fgi. 46. Second leg.
Figs. 47–48. Male of *Lernanthropus latis* n. sp.
Fig. 47. Dorsal view of mature male. Fig. 48. First maxilliped.
Figs. 49–52. Female of *Lernanthropus caesionis* n. sp.
Fig. 49. Dorsal view of mature female.
Fig. 50. First and second maxillipeds and first leg.
Fig. 51. Second leg. Fig. 52. Caudal rami and fourth leg.

PLATE VI

Figs. 53–55. Female of *Hatschekia teuthidis* n. sp.
Fig. 53. Dorsal view of mature female. Fig. 54. Antenna.
Fig. 55. Second leg.
Figs. 56–58. Female of *Hatschekia synagris* n. sp.
Fig. 56. Dorsal view of mature female. Fig. 57. First leg.
Fig. 58. Second leg.
Figs. 59–61. Female of *Hatschekia longigenitalis* n. sp.
Fig. 59. Dorsal view of mature female. Fig. 60. First leg.
Fig. 61. Second leg.
Figs. 62–65. Female of *Hatschekia gracilis* n. sp.
Fig. 62. Dorsal view of gravid female. Fig. 63. Second antenna.
Fig. 64. First leg. Fig. 65. Second leg.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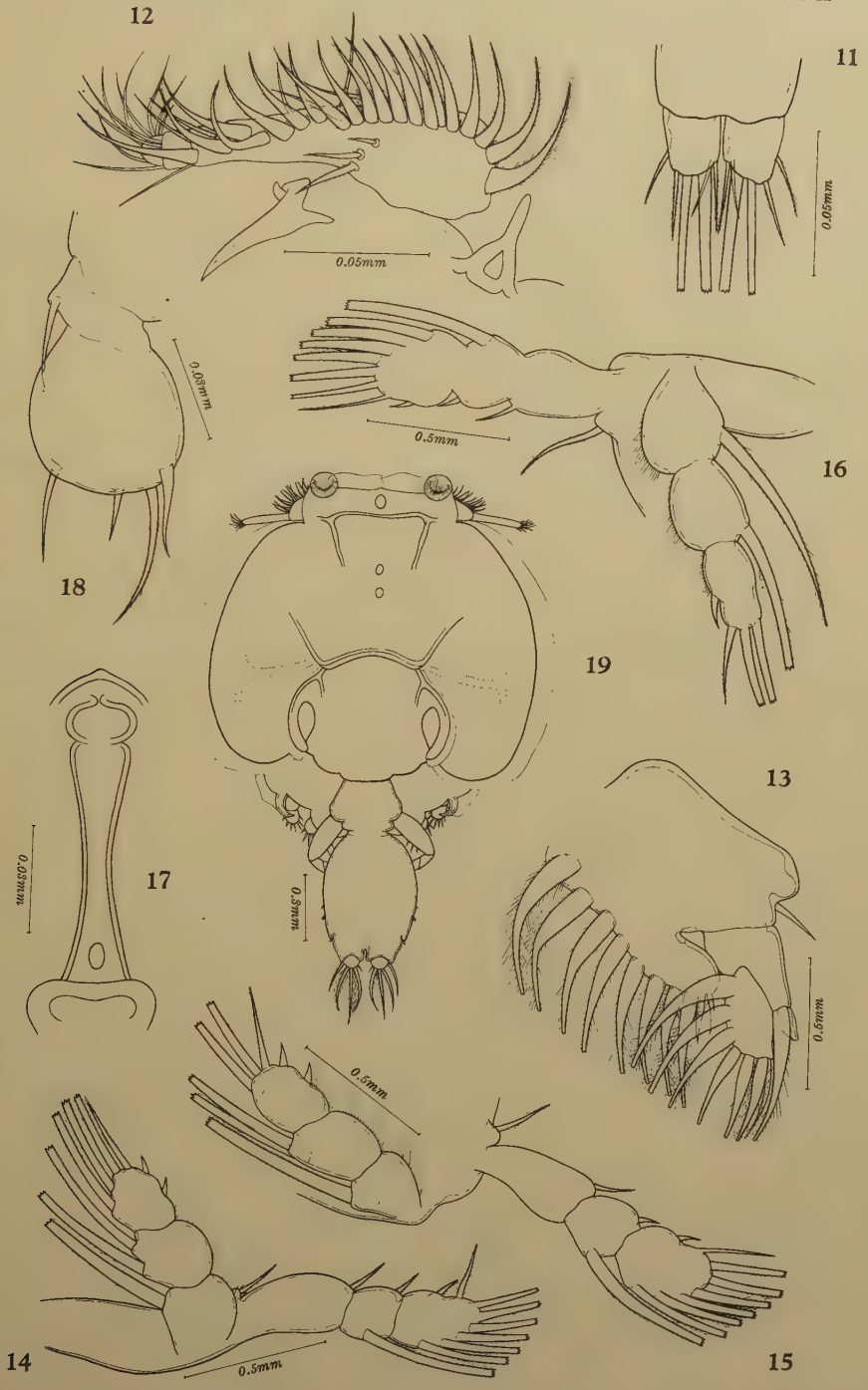
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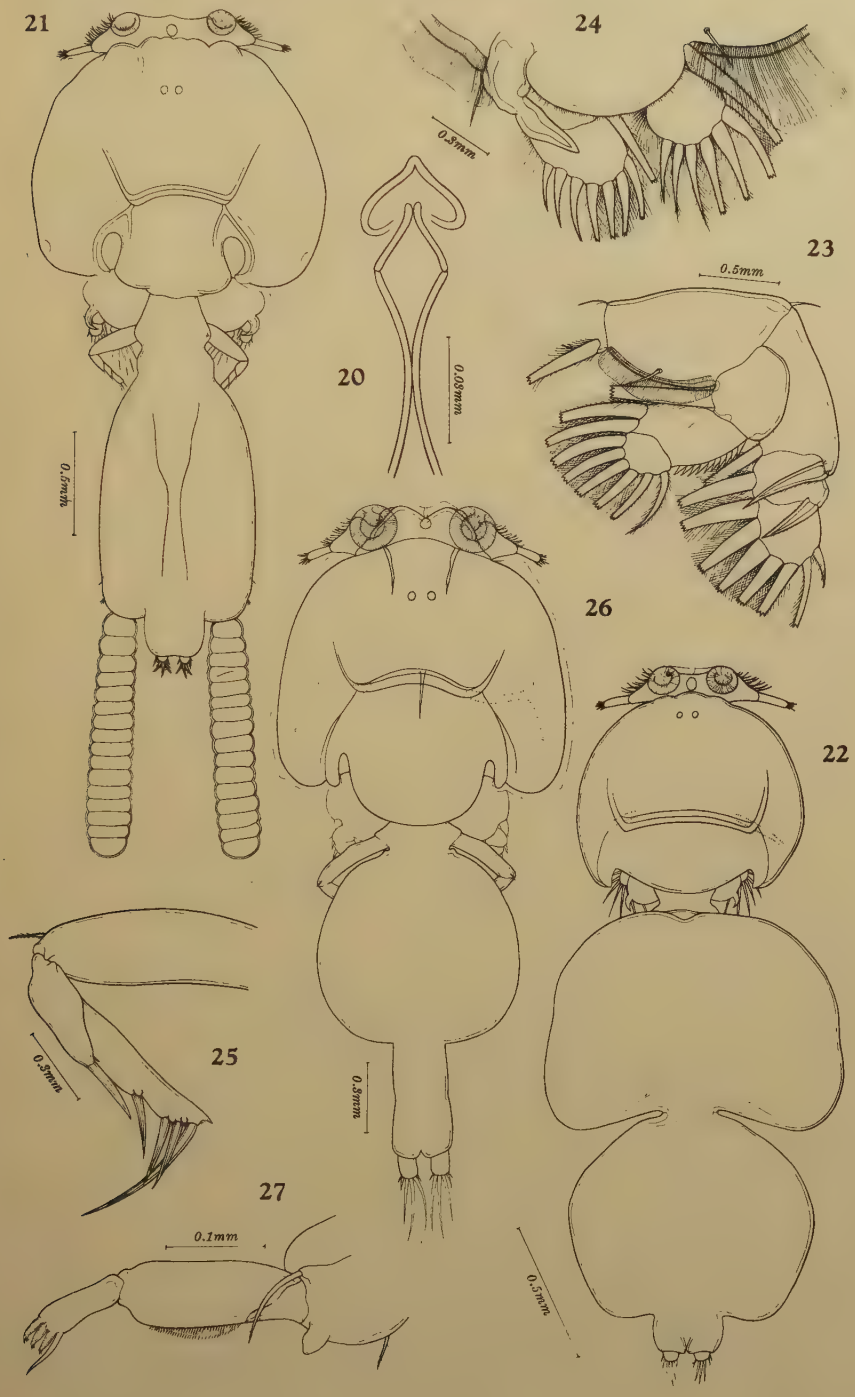
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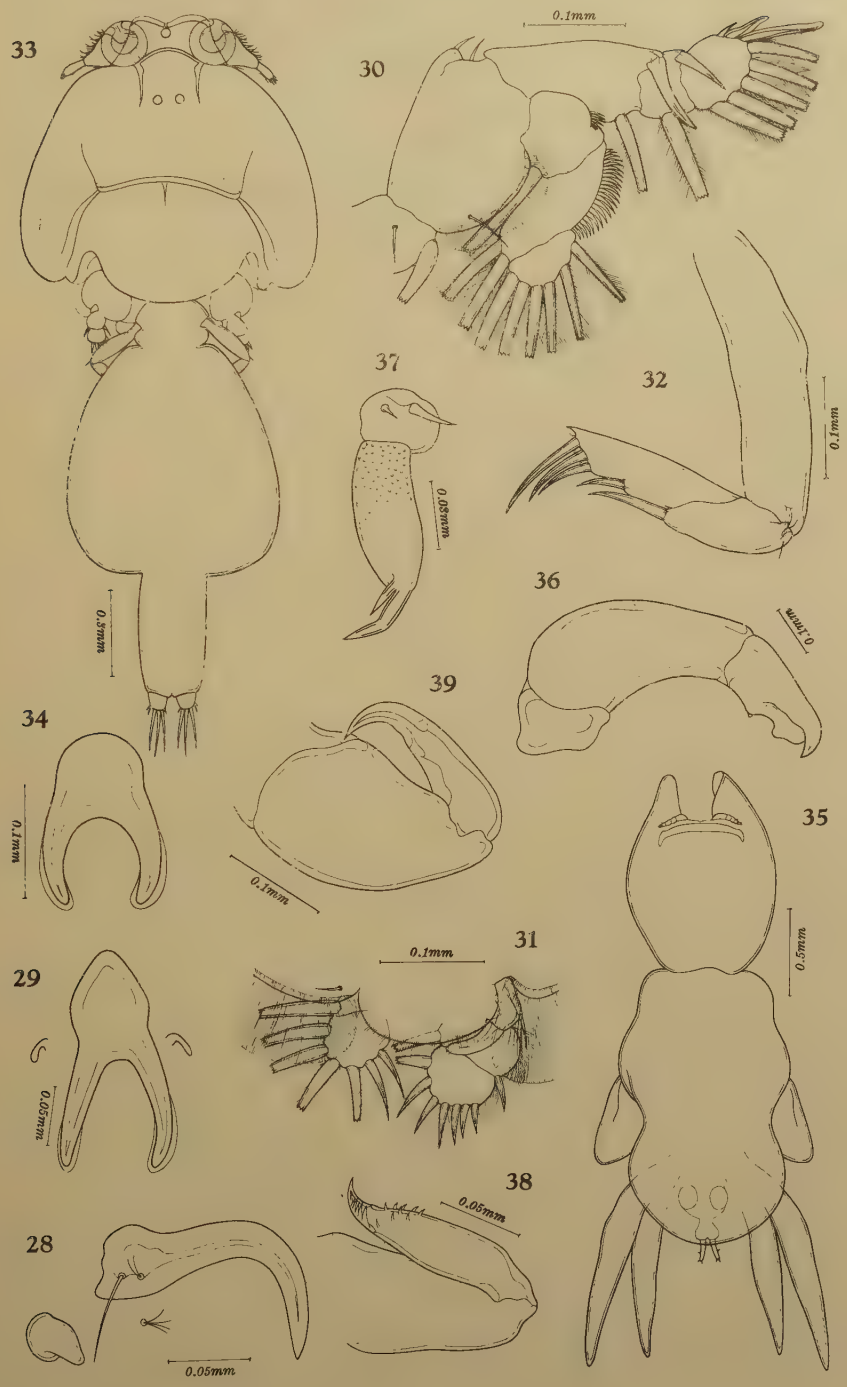
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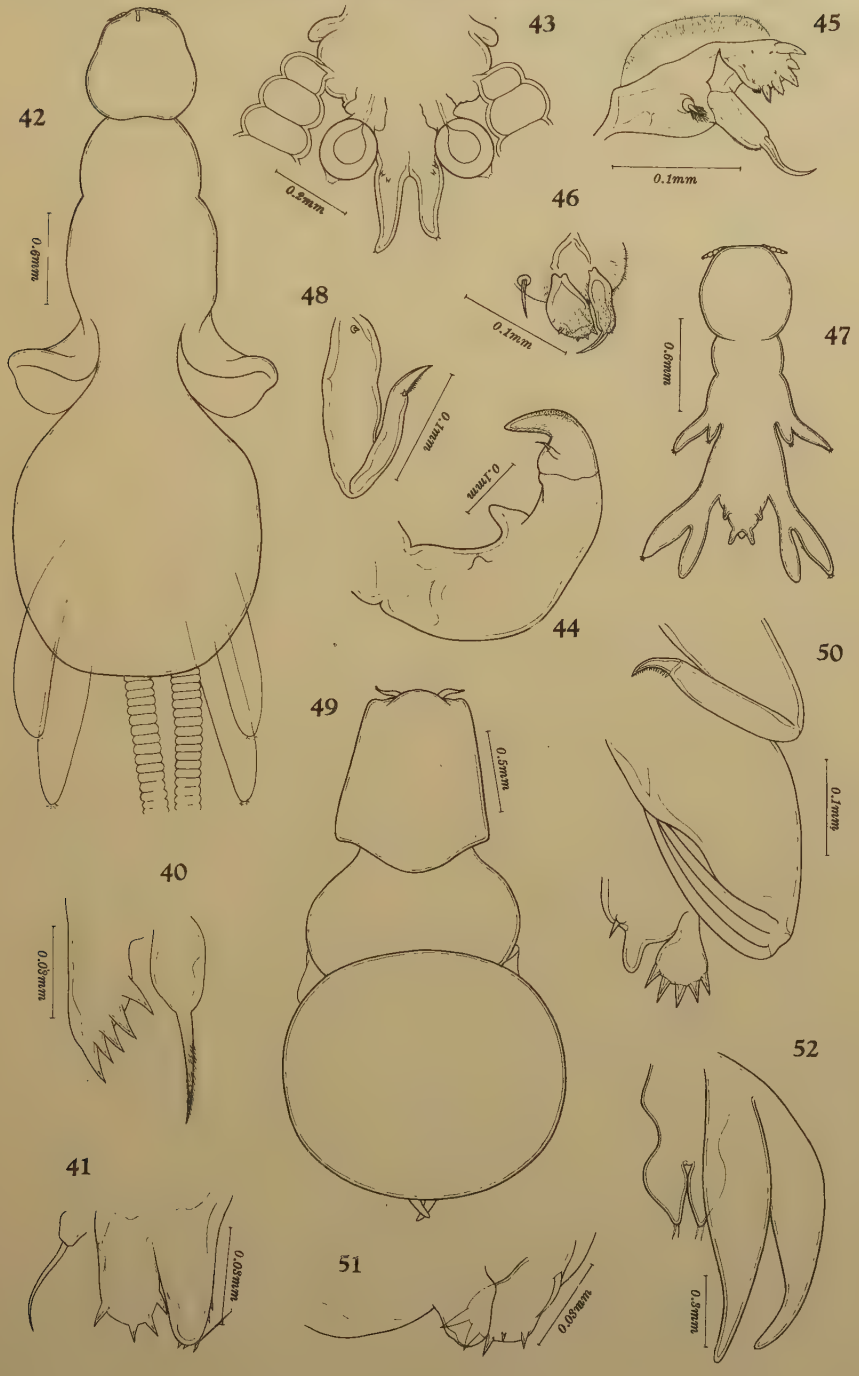
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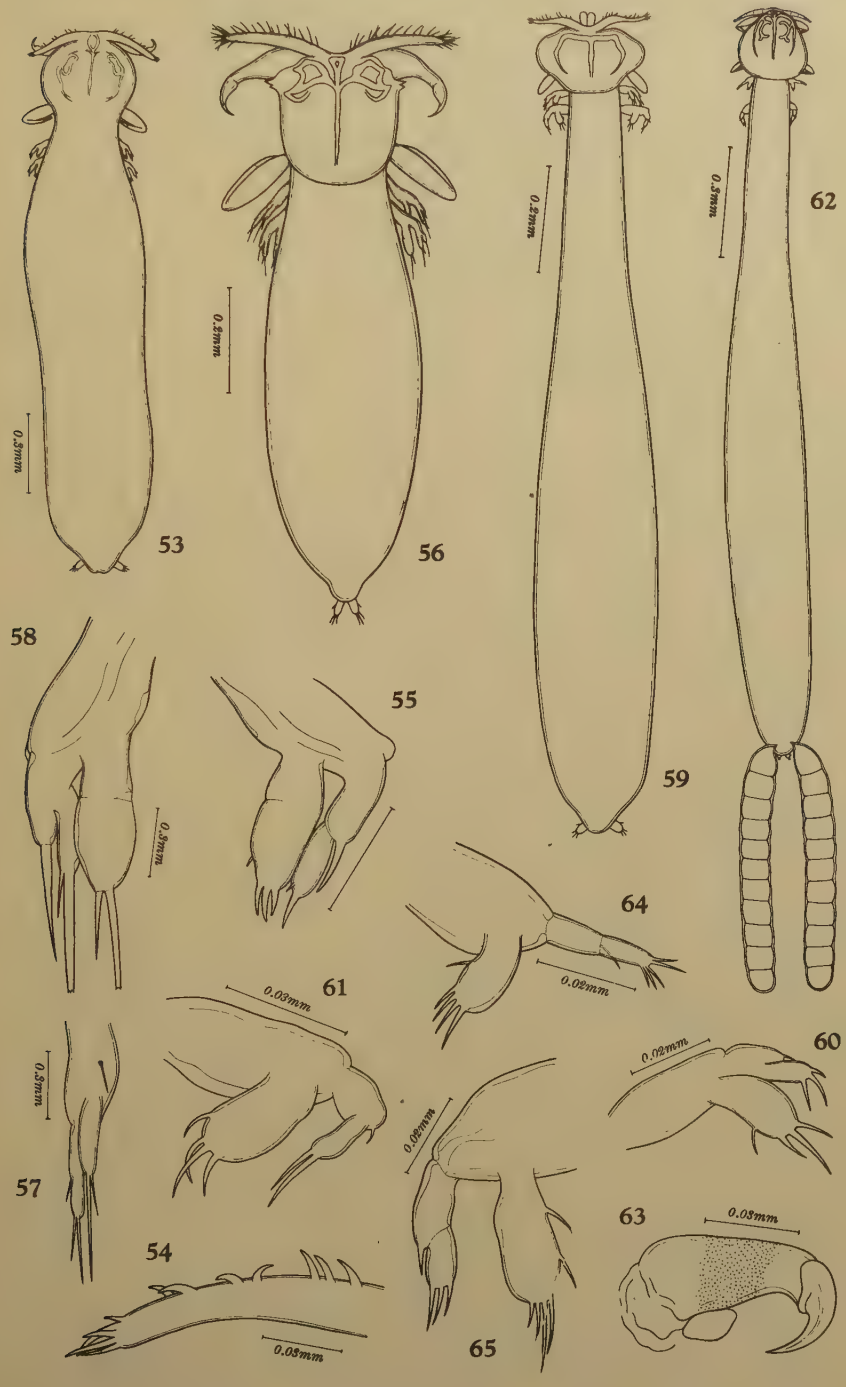
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PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

XI. THE PLANKTON OF KOZIMA BAY IN THE SETO-NAIKAI (INLAND SEA)[1)]

Isamu YAMAZI
Seto Marine Biological Laboratory, Sirahama

With 33 Text-figures

The muddy flat within the western-most areas of Kozima Bay, Okayama Prefecture, covering the extensive delta areas of the two rivers, the Sasagase and Kurasiki, is now reclaiming in order to reform there as paddy fields under the governmental management. Recently the damming work to keep freshwater for irrigation inside is now in progress between the village of Kori and the Okayama Harbour and scheduled to be completed before long. Since the early summer of 1951 a detailed survey was begun of the plankton and bottom fauna of the sea area concerned under the direction of Prof. D. Miyadi of Kyoto University. The principal aim of investigation was to obtain an accurate picture of biological conditions on the grounds to form a basis for an assessment of the changes which occur when such grounds are reclaimed and restored to an agriculturally productive condition. This survey shall be repeated in the coming five years till the damming work will be accomplished.

The present paper deals only with the seasonal changes of the hydrological and planktological conditions in the eastern main area of the bay still to be remained as bay conditions, which has been elucidated by myself took a part of this investigation. As to the problem of succession of the planktonic and benthic fauna and flora within the dammed area which may be expected to result from the reclamation, another interim report now in preparation will be devoted.

During this survey the plankton was hauled at each station from the 3 meter layer to the surface and from the bottom to the 3 meter layer by a Kitahara's quantitative silk tow net in a small scale, equipping with no. XX-13 Müller's gauze. The diameter of the mouth and largest part of the net are 11.25 cm and 25 cm respectively

1) Contributions from the Seto Marine Biological Laboratory, No. 229.

and the length about 50 cm. Therefore, the net passes through the water of approximately 10 liters in every towing for one meter length. General methods of examination are the same as those mentioned in my previous papers of this series. All plankton figures and data imply the volume or number per one meter haul.

Thanks are due to Mr. S. TOKUNO, Director of the Kozima-wan Reclamation and Construction Branch Office of the Ministry of Agriculture and Forestry, and staff members. Prof. S. KAWAGUTI, Mr. K. MATSUMOTO and other members of Okayama University and also Messrs. T. HABE, Y. KUSAKA, H. MAÉDA and S. FUSE of Kyoto University were kind enough to help and cooperate in various ways of this investigation. To all these gentlemen's cooperation I wish to extend here my heartfelt gratitude.

Hydrological Conditions

Kozima Bay is a small bay having an estuarine character situated on the northern coast of the Seto-Naikai (Inland Sea) near Okayama City (Fig. 1). It is about 15 km

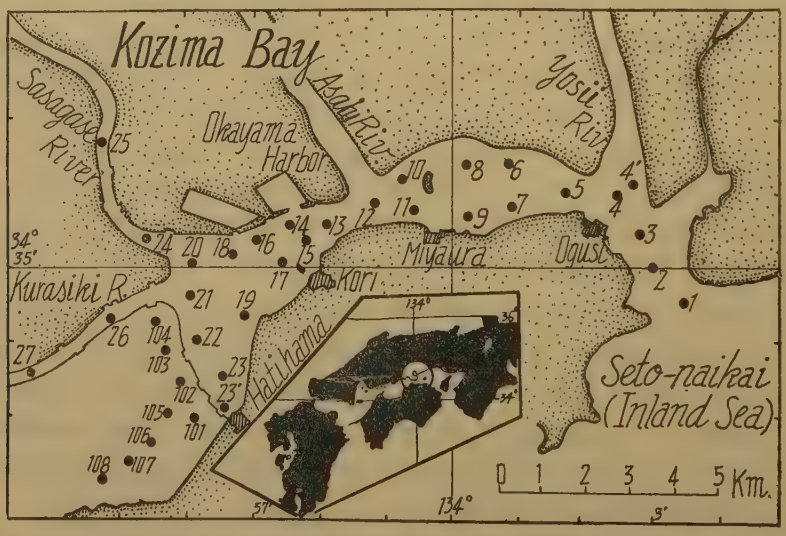


Fig. 1. Chart of Kozima Bay showing stations.

long in the E–W direction and narrowed in the N–S direction. The bay is very shallow, mostly from 3 to 8 m deep (Fig. 2, A). The mouth towards the estuary of Yosii River is a little shallower than the middle region, which forms a lengthwise trench at the depth, about 10–15 m deep. The northern part of the middle region is very shallow less than 2 m in depth, where lies a small islet of Takasima. The inner coastal region is, however, a little deeper, being about 2.5–5 m deep. The bottom

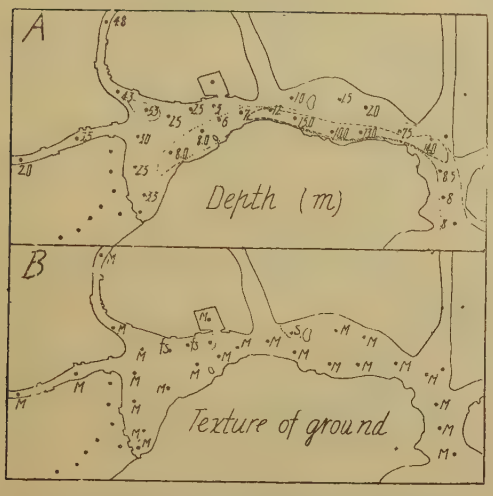


Fig. 2. Map showing bathymetric contours (A), and texture of ground (B). *M*–mud, *S*–sand, *fs*–fine sand.

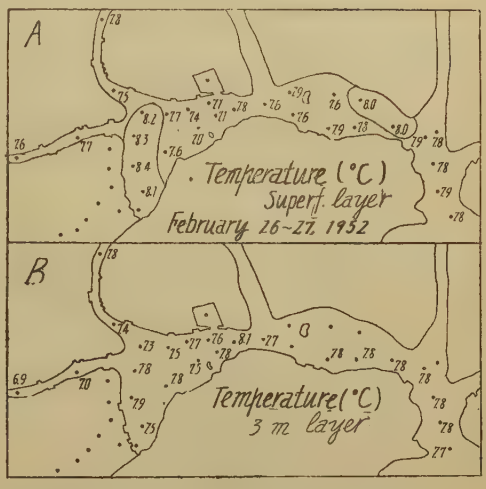


Fig. 3. Distribution of water temperature (°C) during February 26–27, 1952.

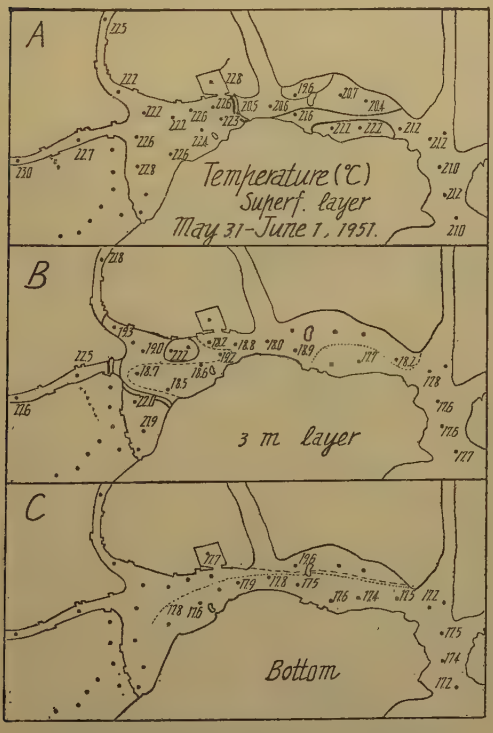


Fig. 4. Distribution of water temperature (°C) during May 31–June 1, 1951.

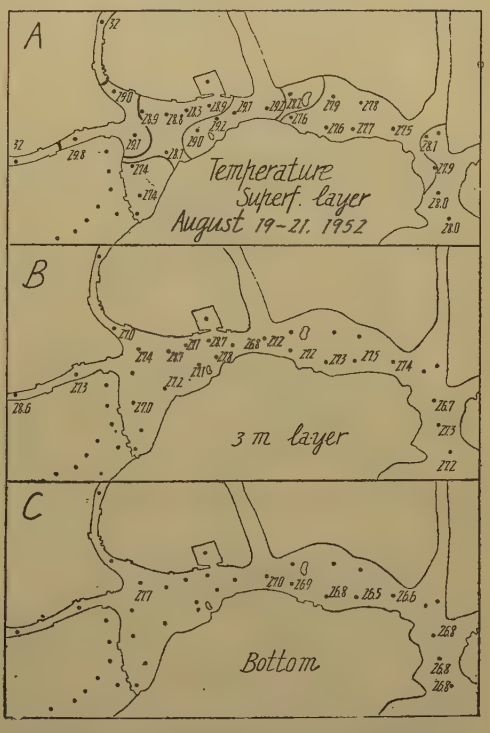


Fig. 5. Distribution of water temperature (°C) during August 19–21, 1952.

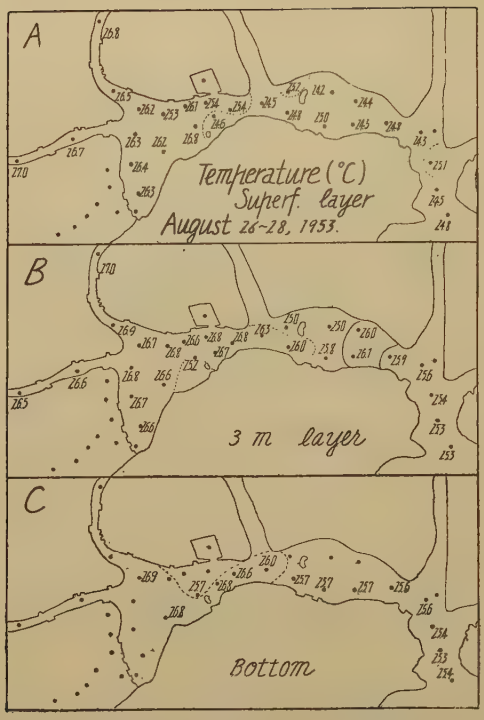


Fig. 6. Distribution of water temperature (°C) during August 26–28, 1953. (Left)

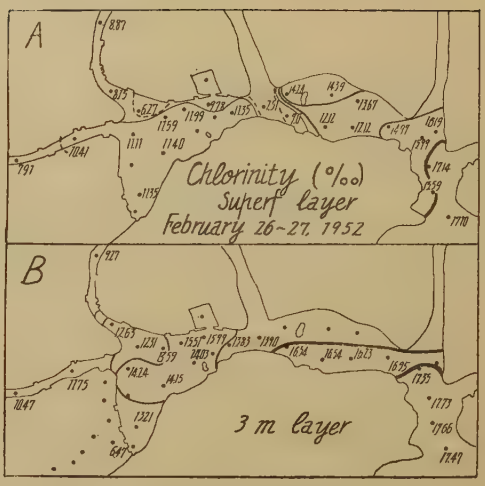


Fig. 7. Distribution of chlorinity in ‰ during February 26–27, 1952. (Above)

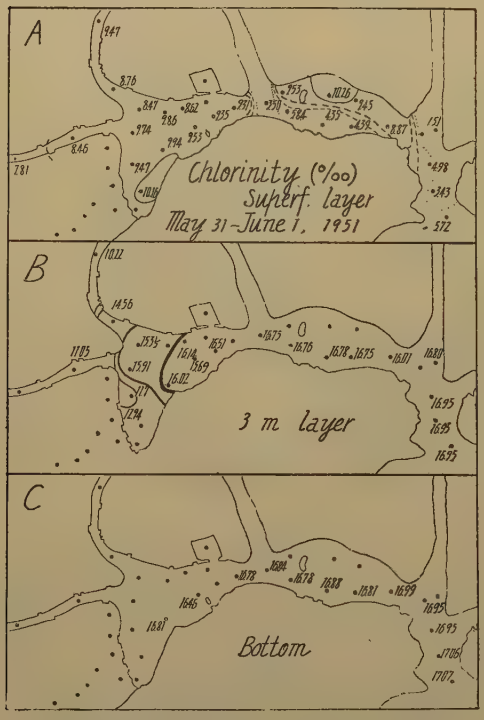


Fig. 8. Distribution of chlorinity in ‰ during May 31–June 1, 1951.

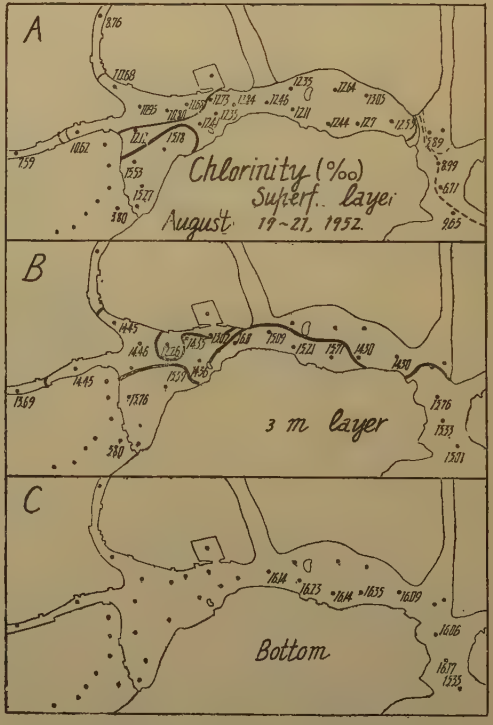


Fig. 9. Distribution of chlorinity in ‰ during August 19–21, 1952.

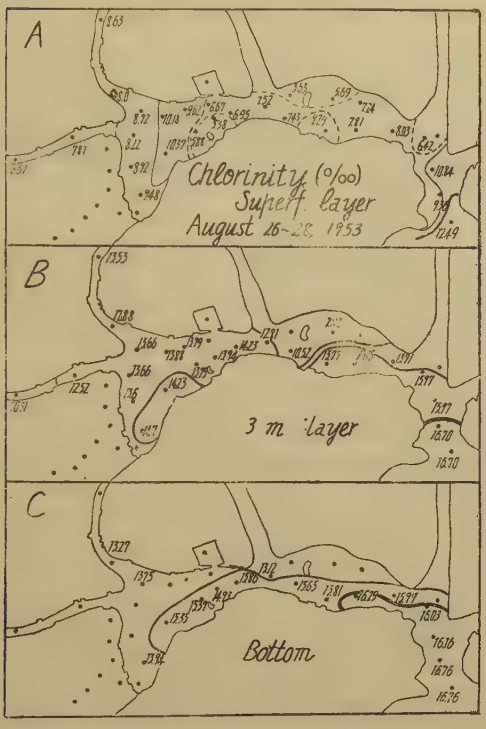


Fig. 10. Distribution of chlorinity in ‰ during August 26–28, 1953.

is uniformly muddy (Fig. 2, B). The bay is poured by four large rivers, the Kurasiki, Sasagase, Asahi and Yosii. Mr. MAÉDA, one of our co-workers, observed the hydrological influences of these rivers on any region of the bay and stochastically analysed (MAÉDA, H. Publ. Seto Mar. Biol. Lab., II (2), p. 249, 1952).

For convenience' sake, the bay water may be treated separately into the surface (bay water with rich freshwater) and bottom waters (with rich Inland Sea water), although it is difficult to give definitely the boundary between them.

Water temperature (Figs. 3–6): Generally speaking, the stratification of temperature is distinctly defined in observations made during May 31– June 1, 1951. The lowest temperature (7.0°C) recorded is during February 26–27, 1952, and the highest (29.7°C) at the surface during August 19–21, 1952. During May 31–June 1, 1951, the surface water was warmer than the lower water. The temperature increased towards both inner and outer shallower layers. In midsummer the water temperature is almost similar from surface to bottom. Further details are shown in Figs. 3 to 6.

Chlorinity (Figs. 7–11): Chlorinity is the most satisfactory hydrological property for indicating the extent of mixing between the sea and freshwater, and its distribution is important in determination of the gradient of the sea water. And from the biological

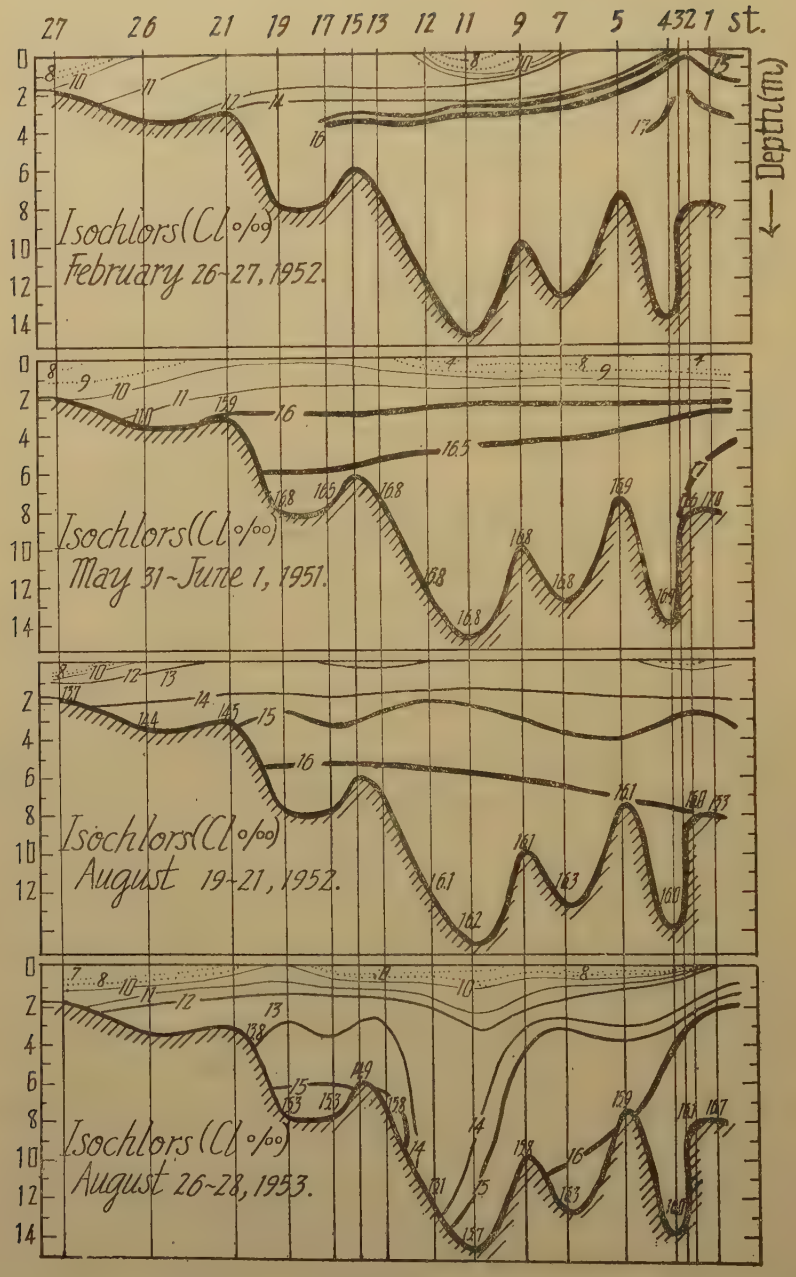


Fig. 11.
Variation of chlorinity in longitudinal section of the bay in different seasons.

standpoint the chlorinity distribution is a main factor in determining the distribution of marine, brackish and freshwater organisms.

In the shallow tide-influenced inner and northern basin of the bay, the chlorinity is generally low, even towards the bottom. In the deep layer from the mouth to the area along the southern coast, the water is comparatively more saline than elsewhere. The minimum chlorinity was observed in February 26–27, 1952 and the maximum in August 26–28, 1953, corresponding to the seasonal variation in river drainage. The vertical gradients at the mouth and the area along the southern coast extending from Sts. 5 to 19 were small except in the surface layer (Fig. 11). These subsurface water in the areas shows the characteristics of Inland Sea water.

Silicates (SiO_2) (Figs. 12, A–C and 13): The silicates of the bay were generally large. The seasonal change was large both horizontally and vertically. The maximum was observed at the surface during August 26–28, 1953, as large amounts of silicates were discharged from the four rivers. The silicates were generally maximum in less

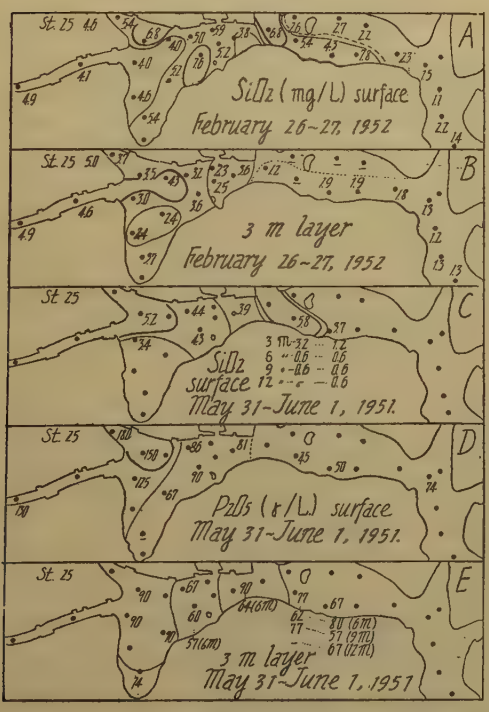


Fig. 12. Distribution of silicates (SiO_2 mg/L) and phosphates (P_2O_5 γ/L). (Above)

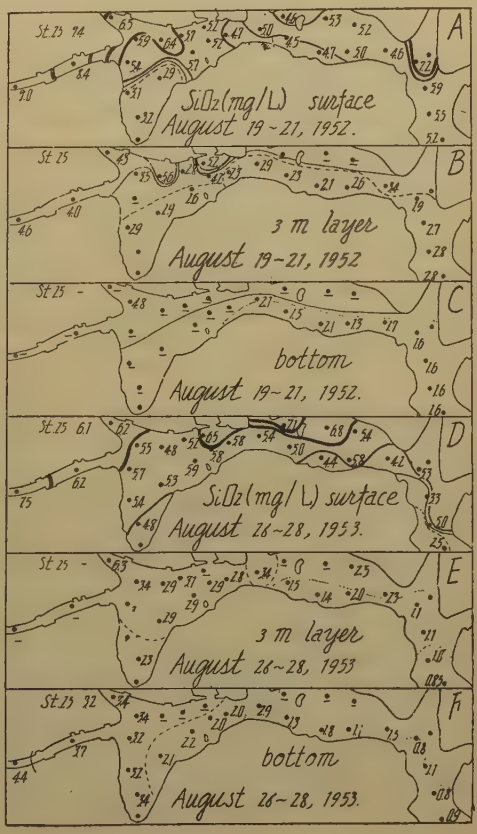
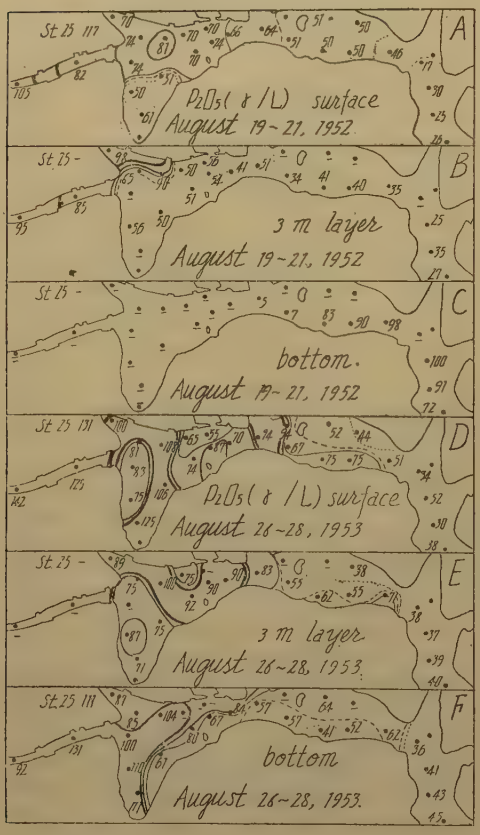


Fig. 13. Distribution of silicates (SiO_2 mg/L). (Right)

saline water in the shallower inner area and minimum in the highly saline water entering from the mouth of the bay.

Phosphates (P_2O_5) (Figs. 12, D, E and 14): The phosphates (P_2O_5) were largest in the inner region with 80–180 mg per cubic meter, and in the middle region with 60–80 mg per m^3, as observed during May 31–June 1, 1951. During August 26–28, 1953, it was also higher in the inner region of the bay than in the middle and outer regions. The lower phosphates were found in the deeper water of the middle region and the mouth. It may be seen that the higher values are characteristic to the estuarine water containing the sewage and polluted land water. The phosphates in this bay were probably derived from bacterial decomposition of organic phosphorus compounds pouring out of sewage.

Transparency (Fig. 15): The transparency of the water was very small at all stations, measuring only about 0.5–2.0 meters. It was smallest in the inner region



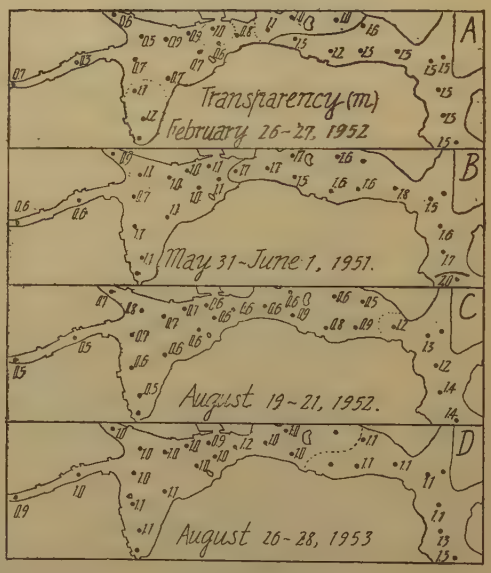


Fig. 15. Distribution of transparency in meter. (Above)

Fig. 14. Distribution of phosphates (P_2O_5) in γ per liter. (Left)

polluted strongly by the water pouring out from the rivers and ponds. It was only slightly higher than 1.5 meters even at the mouth.

Dissolved oxygen (Fig. 16): The dissolved oxygen content was smallest in August in the innermost region especially at the mouth of the Kurasiki. It increased towards the entrance of the bay. It was generally high at all stations during February 26–27, 1952.

Hydrogen-ion concentration (Fig. 17): The distribution of the hydrogen-ion concentration of this bay corresponds closely with that for dissolved oxygen, with high values in the mouth and the deep layer along the southern coast decreasing towards the inner region and estuaries. In the deeper water, low pH values were generally associated with the dissolved oxygen minima especially in summer. The drop in pH value during August 26–28, 1953 is probably due to the increase of carbon dioxide in the water.

Catalytic activity of sea water (Figs. 18 and 19): The catalytic activity of sea water was generally low. The highest value was found in the deeper water where the Inland Sea water stretched along the bottom.

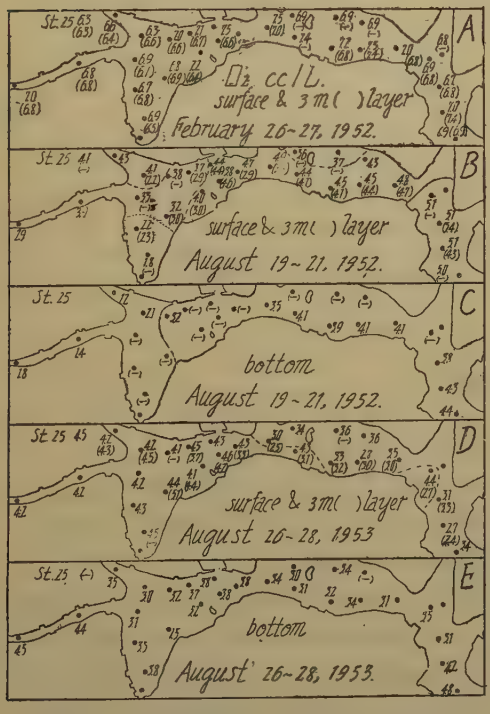


Fig. 16. Distribution of dissolved oxygen concentration in cc per liter.

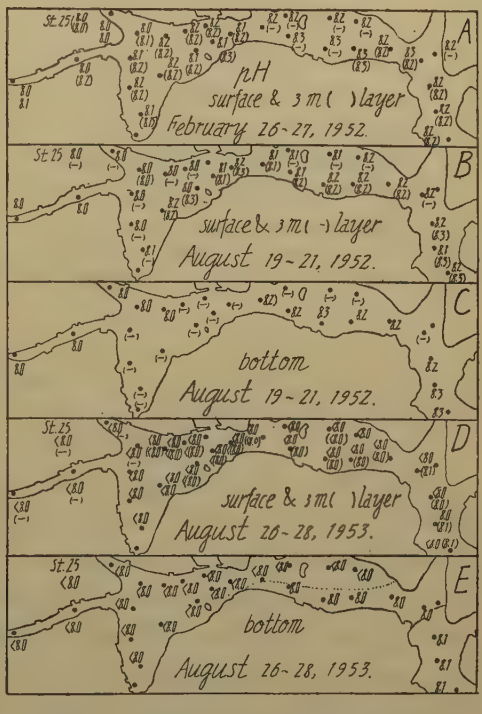


Fig. 17. Distribution of hydrogen-ion concentration (pH).

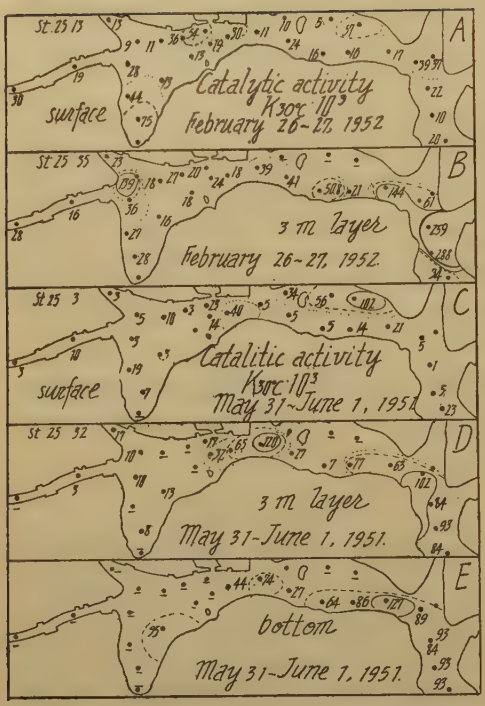


Fig. 18. Distribution of catalytic activity of sea water in $K_{30°C} \cdot 10^3$.
A and B. During February 26–27, 1952.
C, D and E. During May 31–June 1, 1951.

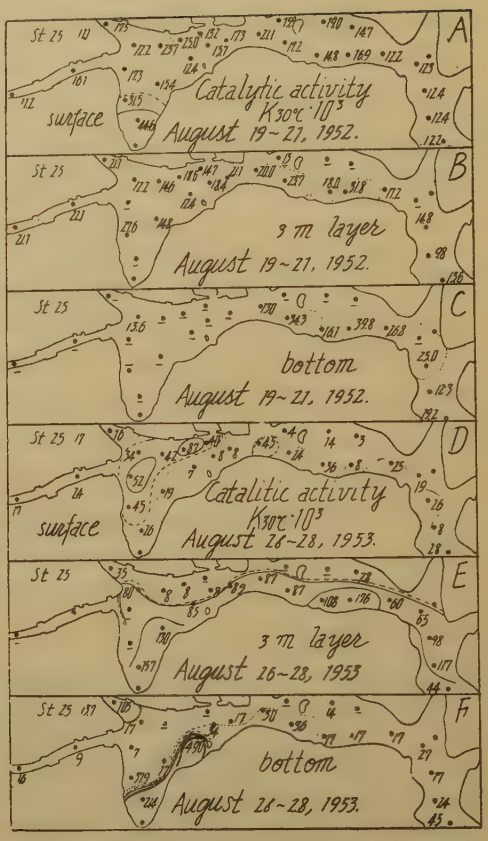


Fig. 19. Distribution of catalytic activity of sea water in $K_{30°C} \cdot 10^3$.
A, B and C. During August 19–21, 1952.
D, E and F. During August 26 28, 1953.

Plankton

A. Quantitative Analysis of Plankton

The total number of plankton was very small in every time of observations and also throughout all stations. The largest number was found at the mouth of the bay, in hauls made during August 19–21, 1952 (Figs. 20 and 21).

The relation between the settling volume and the total number of individuals, cells or colonies of total plankton caught during these surveys from the 3 m layer to the surface are shown graphically in Fig. 22. Both are nearly closely related to each other in the middle and inner regions of the bay in every season, but not so towards the mouth.

Total number per one meter haul increased considerably towards the mouth more than the volume did. In the middle and inner regions, the volume was likewise large, but the number decreased less than that in the mouth. This is due to the different components of plankton, especially the increase in number of copepods and the decrease of phytoplankton in the inner region of the bay. Throughout all stations they were greatest in August and medium in February.

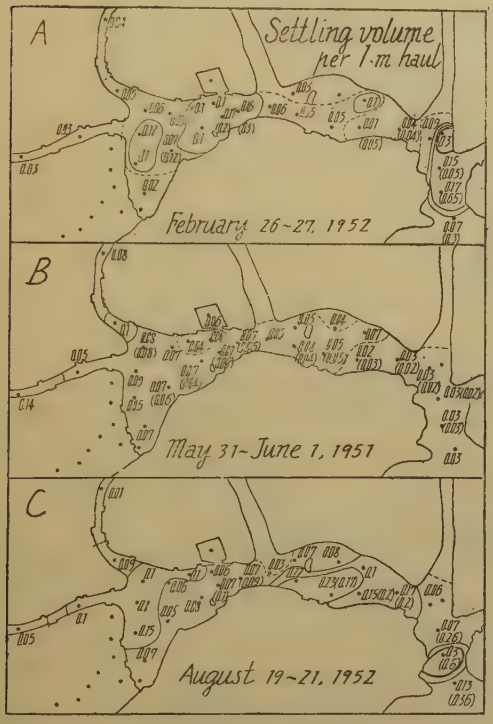


Fig. 20. Settling volume (cc) of plankton per one meter haul from the 3 meter layer to the surface.

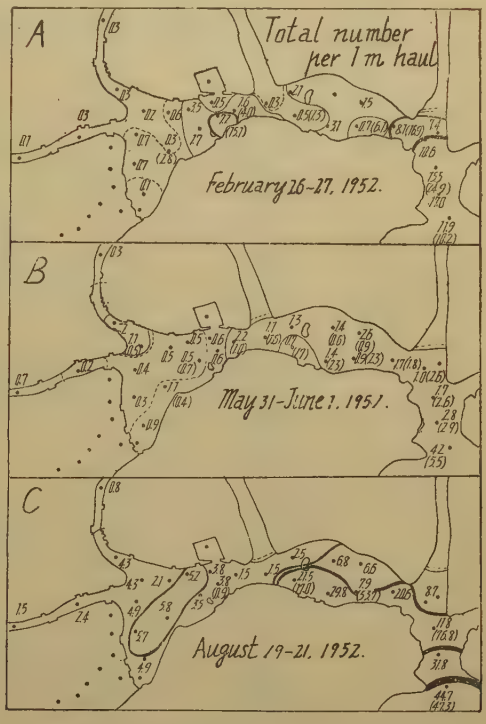


Fig. 21. Distribution of total number of plankton (individuals, cells or colonies) per one meter haul from the 3 meter layer to the suface (Unit of number is thousand).

The zooplankton was found densest in the inner region, where the number reached 1,000–5,000 per one meter haul during August and followed by 300–1,000 during May–June. The population of zooplankton was generally richest in the inner region and the neighboring rivers. The phytoplankton was whenever very scarce throughout all stations. It was, however, fairly richer in the mouth and the area along the southern coast of the middle region than in the innermost region.

The numerical percentage of zooplankton in total plankton was very large in the inner region of the bay, where it reached more than 90%, next in the middle, varying

from 30 to 80% (Fig. 23). It was smallest in the mouth, particularly during February 26, 1952. On the other hand the percentage of phytoplankton was very scarce whenever. Relatively dense population of phytoplankton was found solely along the southern coast of the middle region from the mouth.

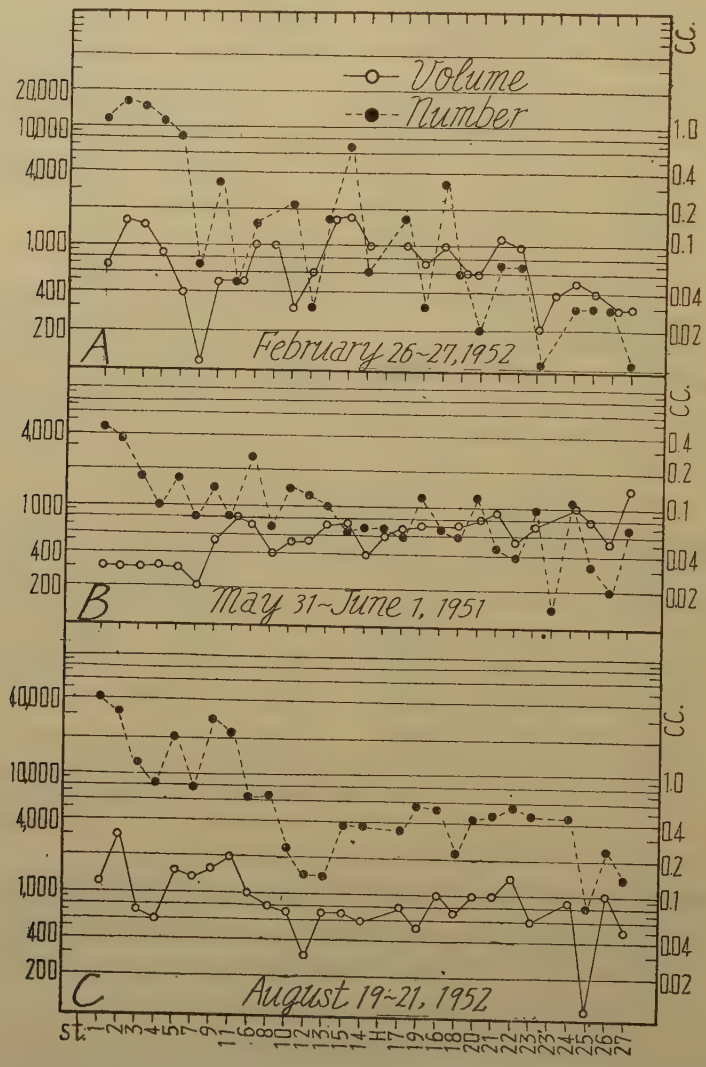


Fig. 22. Relation between settling volume (cc) and number of individuals, cells or colonies per one meter haul.

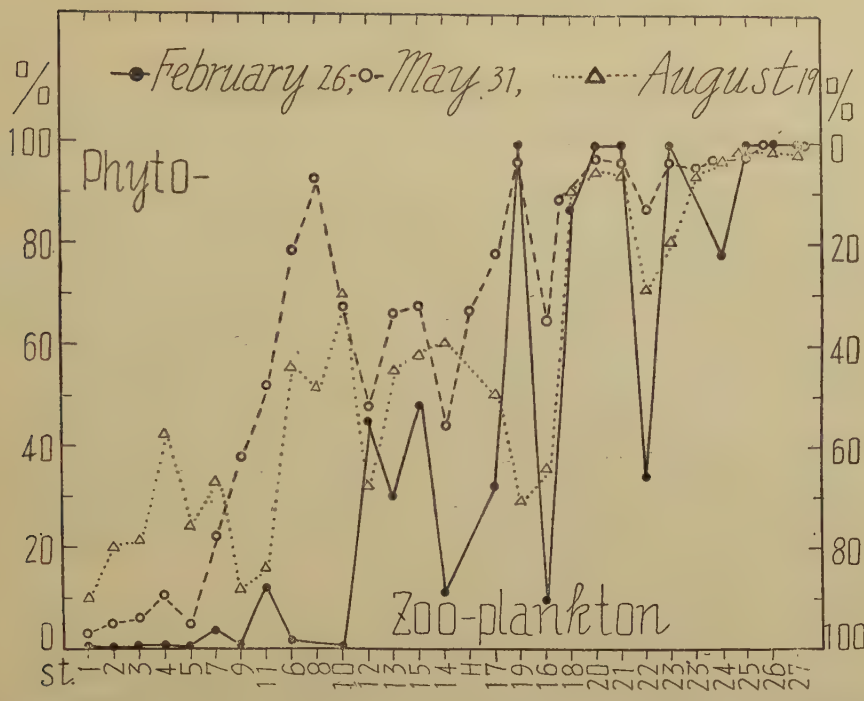


Fig. 23. Percentage composition between total number of zoo- and phytoplankton per one meter haul.

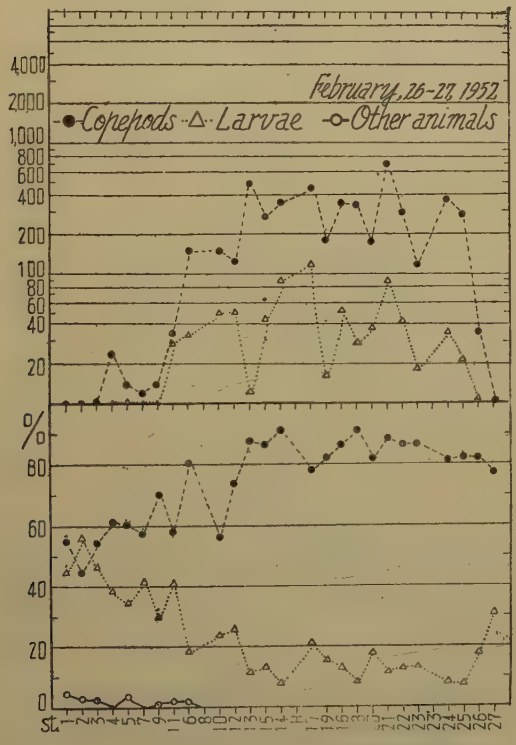


Fig. 24. Population of zooplankton groups per one meter haul (top), and their percentage composition (bottom) during February 26–27, 1952.

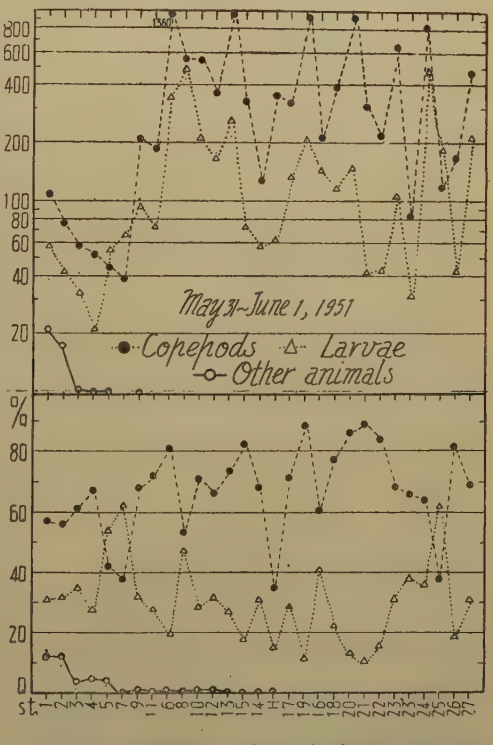


Fig. 25. Population of zooplankton groups per one meter haul (top), and their percentage composition (bottom) during May 31–June 1, 1951.

B. Qualitative Analysis of Plankton

ZOOPLANKTON

The occurrence and maxima of the main zooplankton groups are summarized in Figs. 24, 25 and 26. It is clear that they are characterized not only by the local abundance of the main components but also by their composition. The main group was as usual copepods at anytime, and followed by larval forms. The other animals were very poor throughout all stations. The smallest number was encountered during February 26–27, 1952, although observed a small number of copepods and larval forms.

The copepods as well as the larval forms were relatively numerous towards the inner region. The population of copepeds was greater during May 31–June 1, 1951 than during February 26–27, 1952. The larval forms of copepods also occurred abundantly. During August 19–21, 1952, the bulk of large population of copepods and

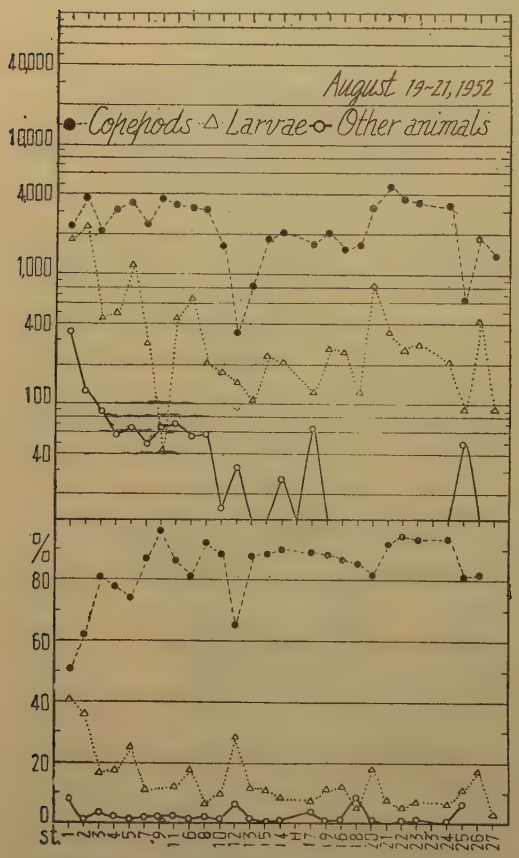


Fig. 26. Population of zooplankton groups per one meter haul(top), and their percentage composition (bottom) during August, 1952.

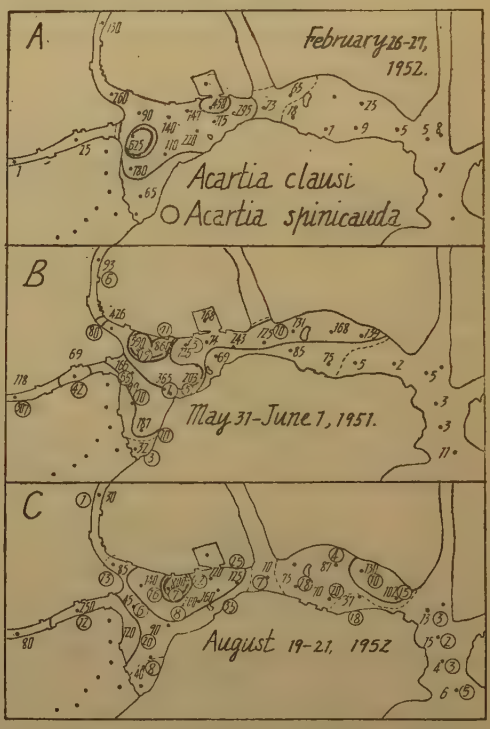


Fig. 27. Distribution of *Acartia clausi* and *A. spinicauda* showing the seasonal variation in occurrence.

their larval forms were noticed at all stations. The other animal groups only found in the mouth and the southern part of the middle region except during August were considerably scarce.

The following copepods were found dominantly: 1) *Sinocalanus tenellus*, 2) *Pseudodiaptomus inopsis*, 3) *Acartia clausi*, 4) *Acartia spinicauda*, 5) *Oithona nana*, 6) *Paracalanus parvus*, 7) *Euterpe acutifrons*, 8) *Centropages* sp. 9) *Oithona similis*, 10) *Microsetella rosea*, 11) *Corycaeus crassiusculus*.

Figs. 27–29 show the distribution of four predominant copepods with numerical abundance. During February 26–27, 1952, there was found a few species and the total population was relatively small. *Acartia clausi* was the most numerous component especially in the inner part of the bay. *Oithona nana* was relatively rich in the northern part of the inner region, but very poor towards the middle and mouth region. The real brackish water forms, such as *Sinocalanus tenellus* and *Pseudodiaptomus inopsis*, were recorded only sporadically in the innermost part and estuaries of the Kurasiki and Sasagase. *Paracalanus parvus*, *Oithona similis* and small numbers of *Microsetella rosea* and *Corycaeus crassiusculus* occurred only in the mouth region of the bay.

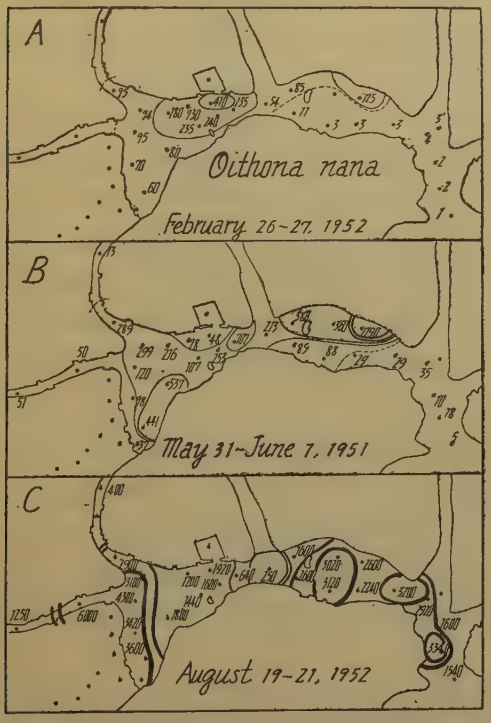


Fig. 28. Distribution of *Oithona nana* showing the seasonal variation in occurrence.

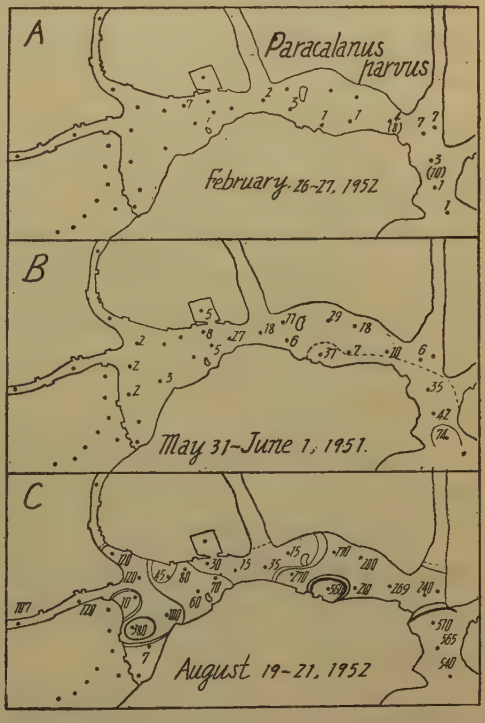


Fig. 29. Distribution of *Paracalanus parvus* showing the seasonal variation in occurrence.

During May 31–June 1, 1951, these species remarkably increased, and in addition *Acartia spinicauda* appeared for the first time in the inner region of the bay, particularly near the estuaries (Fig. 27, B). The other copepods showed the similar distribution as before.

During August 19–21, 1952, all these copepod populations enormously increased and probably reached their maximum; *Oithona nana* and *Paracalanus parvus* were rather widely distributed, while *Acartia clausi*, *Acartia spinicauda*, together with *Sinocalanus tenellus* and *Pseudodiaptomus inopsis* were rather restricted to the inner regions, and *Microsetella rosea*, *Corycaeus* and *Oithona similis* were only found sparsely mouth of the bay.

The percentage composition of these main copepods in different seasons is summarized graphically in Figs. 30, 31 and 32. In the inner region of the bay, *Acartia spinicauda* was the most abundant during early summer, though absent in winter. This is an inshore and brackish water form living in waters of relatively low salinities. In Jû-san Gata, KOKUBO and SATO (1947)[1] found it very commonly in low saline water with 2.49–16.15‰ Cl. *Acartia clausi*, on the other hand, is more widely distributed than *Acartia spinicauda* and can thrive in cold waters. It is found abundantly in every season, except in hot midsummer. *Oithona nana* was the most predominant in every season except in the innermost part during early summer and occurred very abundantly everywhere.

Besides copepods, *Podon* was often observed in August. A chaetognath *Sagitta crassa*, *S. crassa* f. *naikaiensis* and a tunicate *Oikopleura dioica* were found sparsely in the mouth of the bay in February and August, but rather abundant in May–June. A rotifer *Synchaeta* sp. occurred widely at all stations, though in small numbers. Among tintinnoids, *Tintinnopsis mortensenii*, *T. nordqvisti*, *T. radix*, *T. beroidea*, *Favella ehrenbergii* and *F. campanula* were frequent in the mouth to the southern coast of the middle region in August alone. *Noctiluca*, on the other hand, was found only in February.

The main components of larval forms were copepod nauplii. The larvae of polychaetes, veligers of pelecypods and gastropods, Ophiopluteus and nauplii of cirriped were small in abundance. Copepod nauplii which were mostly represented by *Oithona nana* and *Acartia* were frequent everywhere in all seasons. The larvae except copepod nauplii were generally restricted to the mouth and the southern area of the middle region.

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1) KOKUBO, S. and SATO, S. 1947. Plankters in Jû-san Gata. Physiology and Ecology, Vol. 1, No. 4, pp. 209–224.

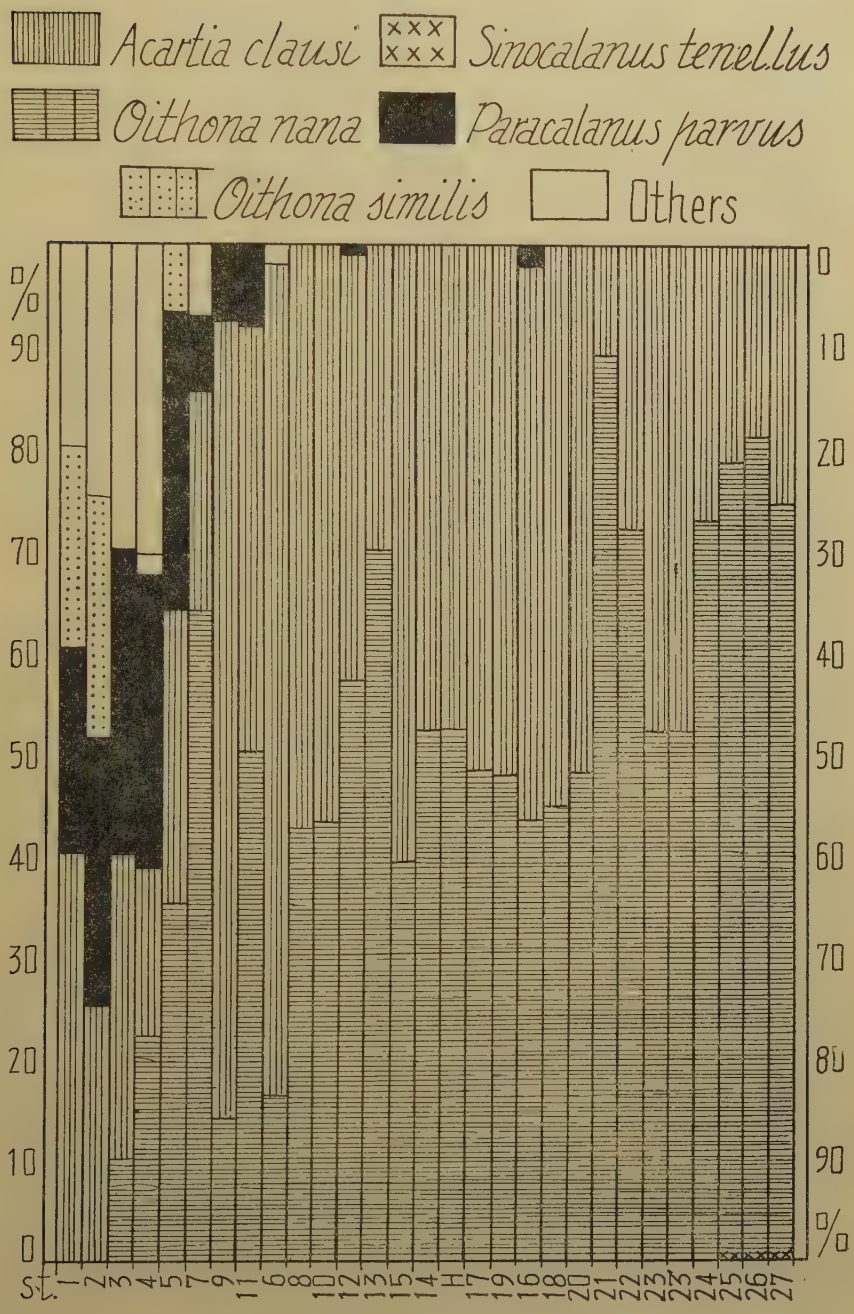

Fig. 30. Percentage composition of important copepods per one meter haul during February 26–27, 1952.

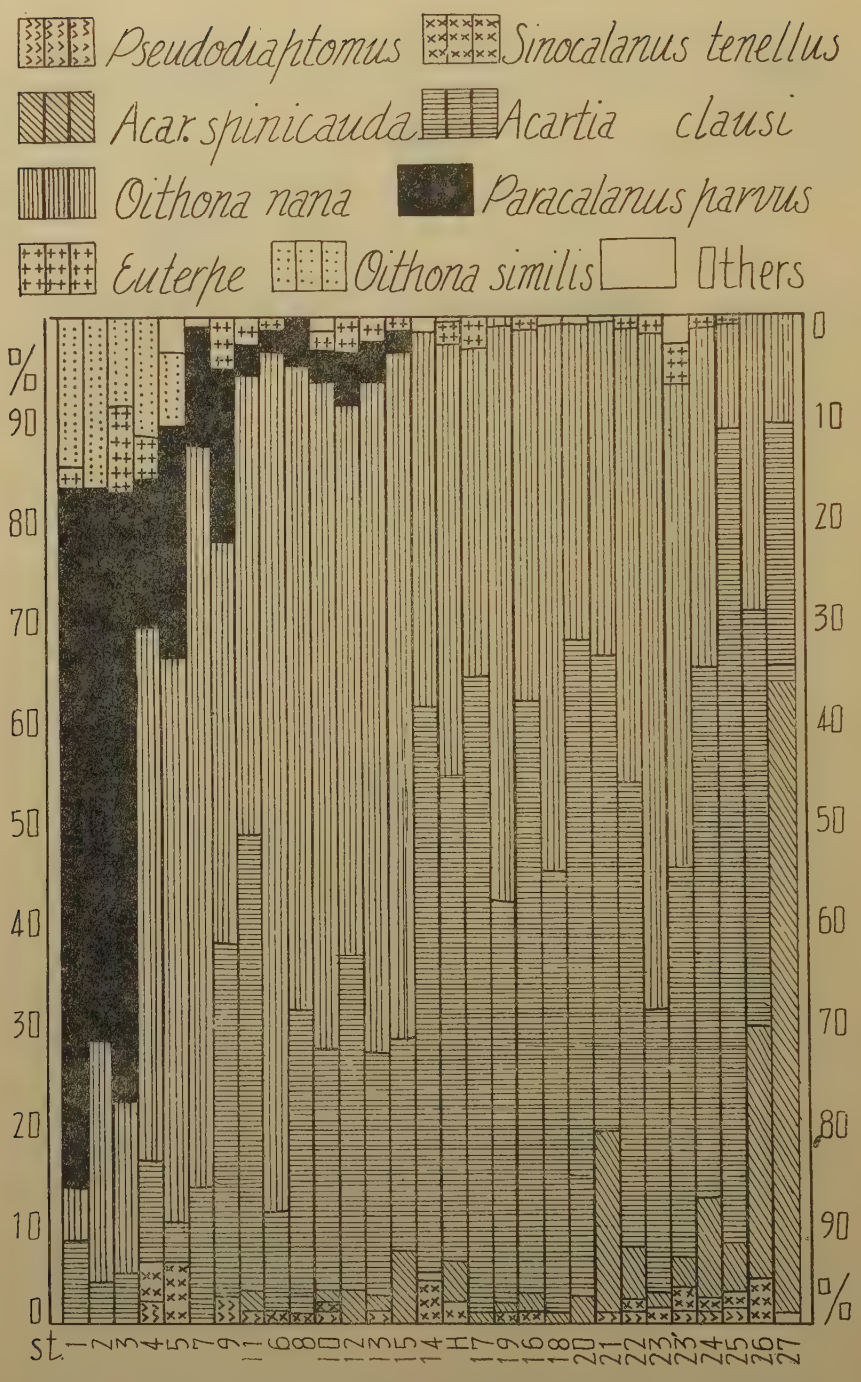

Fig. 31. Percentage composition of important copepods per one meter haul during May 31–June 1, 1951.

PHYTOPLANKTON

The population and composition of phytoplankton of this bay are characterized by, 1) the general paucity in occurrence, 2) the distribution limited to the southern part of the middle and mouth regions, and 3) the relatively small number of species except in summer.

Phytoplankton during February 26–27, 1952: The total number was very small, only less than 20 thousands as cells or colonies per one meter heul at the richest station near the mouth of the bay. The main component was diatoms, such as *Rhizosolenia setigera* (less than 7 thousands per one meter haul), *Rh. alata* forma *gracillima* (less than 0.3 thousands), *Asterionella japonica* (less than 4 thousands), *Chaetoceros* spp. (less than 7 thousands) and *Coscinodiscus* spp. (less then 1.5 thousands). The species occurred only in the mouth and the southern coast of the middle region. The other 33 species were found near the mouth, but they were very small in number. The dinoflagellates were very scanty, only *Ceratium fusus* and *Cer. intermedium* being found in the mouth.

Phytoplankton during May 31–June 1, 1951: The total number was smaller than in the preceding season, though showing the similar distribution. It was only less than 6 thousands per one meter haul at the richest station near the mouth. The important species was *Thalassiothrix Frauenfeldii*, *Biddulphia mobiliensis*, *Rhizosolenia calcar avis*, *Chaetoceros affinis* and *Chaetoceros decipiens*. The other 38 species of diatoms were restricted to the mouth very scantily. *Ceratium fusus* was only very sparsely found in the mouth.

Phytoplankton during August 19–21: The phytoplankton was dominated by diatoms in the mouth region alone. The main diatom species are *Thalassiothrix Frauenfeldii* (less than 5 thousands per one meter haul), *Coscinodiscus stellaris* (less than 16 thousands), *Chaetoceros* (less than 9 thousands), *Coscinodiscus granii* (less than 2 thousands), *Nitzschia seriata* (less than 1.5 thousands), *Rhizosolenia calcar avis*, *Rh. hebetata* f. *semispina* and *Rh. imbricata* (less than 0.4, 0.2 and 0.5 thousands, respectively). The other 29 diatoms were found in the mouth, but they were very sparse in number. Dinoflagellates were a little more numerous than during May 31–June 1, 1951, and represented only by *Ceratium fusus* (less than 90 per one meter haul), *Cer. tripos* (less than 70), *Peridinium depressum* and *Per. oceanicum* var. *oblongum* (less than 400) all of which occurred in the mouth.

These data suggest that they were introduced from the Inland Sea by the currents. It should be considered that at least in this bay the less saline and highly polluted waters do not permit to flourish for diatoms and dinoflagellates, although nutrient salts such as phosphates and silicates are very abundantly contained throughout the year. Generally, there was no direct correlation by grazing between zooplankton and phyto-

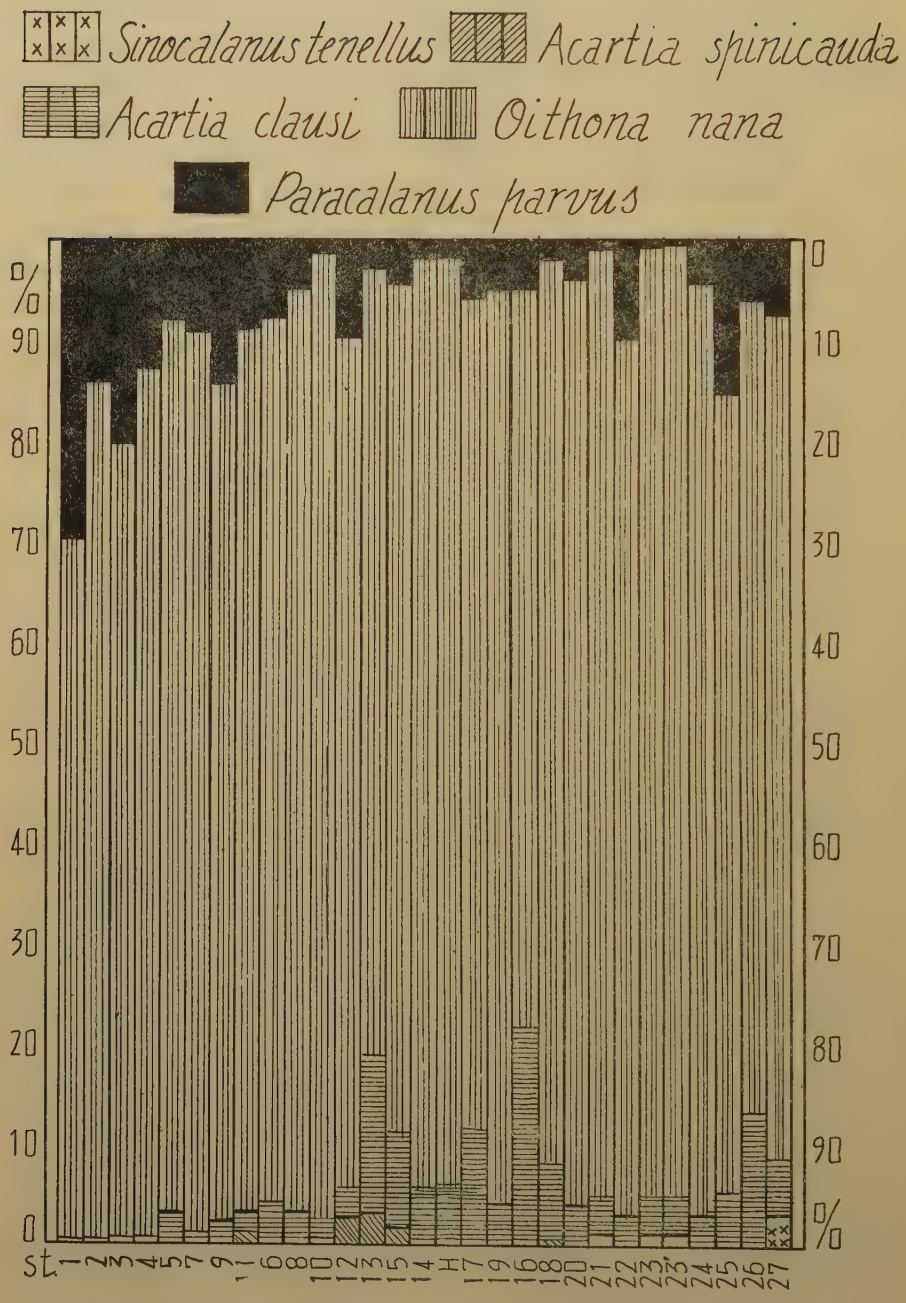

Fig. 32. Percentage composition of important copepods per one meter haul during August 19–21, 1952.

plankton. The zooplankton, especially copepods, were always abundant, while the phytoplankton less numerous at all stations.

Consideration on Regional Distribution

From the preceding data it is obvious that Kozima Bay possesses an estuarine environment, which is influenced by tide, but it is not the actual brackish water environment subject to dilutions by freshwater and rainwater and not influenced by tidal movement. The plankton in the bay seems to be rather monotonous in composition and uniform in abundance, but its distribution is correlated with the topographical and hydrological conditions. The distributions of the dominant copepods and its associates and their seasonal variations in Kozima Bay during the periods 1951–53 are summarized as follows (Fig. 33) :

1. *Acartia clausi* community.

A real inshore copepod *Acartia clausi*, which is fairly euryhaline and eurythermal, appears all the year round, but is comparatively abundant from winter to early summer. The main habitat is, however, rather confined to the narrow area of less saline waters of the innermost region. It is associated with *A. spinicauda* in summer and also with a large number of *Oithona nana* in all seasons. Other associates are brackish water copepods such as *Sinocalanus tenellus* and *Pseudodiaptomus inopsis* in early summer. The marine diatoms are not found at all within the area where this community keeps its predominance. Thereabout the water shows very low transparency, low catalytic activity and very low salinity.

2. *Oithona nana* community.

The whole area of the bay is densely occupied by a widespread inshore form *Oithona nana*. In is associated with *Acartia clausi* and *A. spinicauda* in the inner region and with *Paracalanus parvus* and *Oithona similis* in the outer region. Other associates in the outer region are *Oncaea* sp., *Oikopleura dioica*, *Sagitta crassa* f. *naikaiensis*, etc. In this community the following two faciations may be recognized.

(a) *Oithona nana—Acartia clausi* community.

In the inner area *Oithona nana* occurs with rich *Acartia clausi*. *Oithona nana* is the most dominant copepod of all zooplankton in this bay, widespread in all areas, and predominates especially in midsummer. In other seasons, it is also found abundantly in the wide area from the inner to the middle region, but associated with a large number of *Acartia clausi* and a small number of *Euterpe acutifrons*.

(b) *Oithona nana—Paracalanus parvus* community.

The mouth part of the bay is predominated by *Paracalanus parvus* and *Oithona nana* (together with *Oithona similis* except in midsummer). The occurrence of

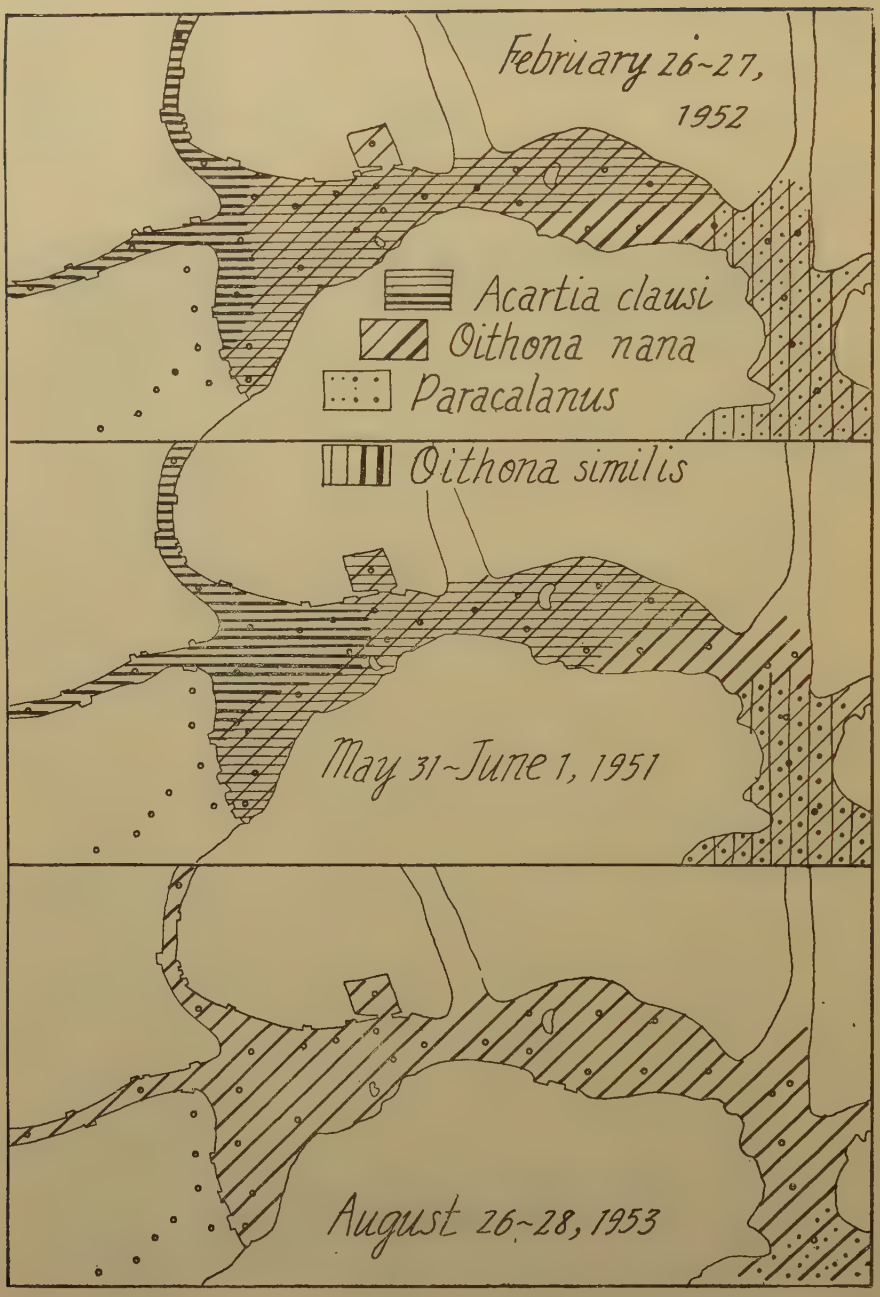

Fig. 33. Distributional map of dominant copepods in Kozima Bay during the periods of February 26–27, 1952 (top), May 31–June 1, 1951 (middle) and August 26–28, 1953 (bottom).

Paracalanus parvus is confined chiefly to the mouth region during the period from winter to early summer, although this area penetrates considerably into the head of the bay in the following summer as revealed by the survey during August 19–21, 1952, when the hydrological conditions of this area were similar to those of the Inland Sea outside the bay, the variations of chlorinity and temperature being relatively smaller than in the inner area of the bay occupied by the preceding communities. The phytoplankton, especially diatoms, is rich around the entrance of the bay. It may therefore be concluded that the major phytoplankton components in this area may be carried in from the Inland Sea during the times when the tidal current is strong and, as a result, the water is turbulent.

In conclusion, the plankton of Kozima Bay is largely composed of the mixed communities of *Oithona nana* and *Acartia clausi*. The outer region is dominated by the former species, while the inner region by the latter. Both populations and almost all the other components are generally encountered all the year round, except only *Acartia spinicauda* found during the warm period. The seasonal variation in quantity is of course observed. The relationship between the numerical abundance of zooplankton and temperature is actually complicated. But in the case of a certain species the number of individuals generally increases with the rise of the water temperature. The productivities of diatoms and dinoflagellates are always very poor in contrast with the dominance of zooplankton. The number of species is also small.

PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

XII. THE PLANKTON OF MIYAKO BAY ON THE EASTERN COAST OF TÔHOKU DISTRICT[1)]

ISAMU YAMAZI
Seto Marine Biological Laboratory, Sirahama

With 16 Text-figures

A plankton investigation of Miyako Bay on the eastern coast of the Tôhoku District, about 40 km north of Kamaisi Bay, was made on October 18, 1952, by the same methods as already employed in Onagawa and Kamaisi Bay (YAMAZI, 1953). The samples were collected at a superficial layer and near the bottom. The 26 stations where samples were collected are shown in Fig. 1. The survey was made possible with the help of Mr. E. YAMADA, of Miyako Fisheries High School and his colleagues whose kindnesses and cooperation are heartily acknowledged.

Hydrological Conditions

Miyako Bay is a wedge-shaped inlet, approximately 9 km long and 3 km wide at the mouth. The coast line around the bay is monotonous, only with a small cape Tatega-saki near the mouth on the west coast. The interior of the bay is not so deep as in Onagawa and Kamaisi Bay, mostly less than 20 meters, except near the mouth where it is about 60-80 m deep. The basin near the mouth of the bay has steep wall on the west and east coasts, but the remaining interior becomes gradually shallower inwards and westwards. Two small rivers pour into the inlet, the Miyako midway on the west coast and the Tugaruisi at the head of the bay. The discharge of freshwater and sewage from Miyako River is relatively large.

Water temperature (Fig. 2, A and B): The water temperature is affected by air temperature and total hour of sunshine. The surface water temperature reached its minimum from the mouth to the middle part along the eastern coast and then increased towards the inner part and western coast. It varied from 16.4°C near the

1) Contributions from the Seto Marine Biological Laboratory, No. 230.

Fig. 1. Chart of Miyako Bay showing stations and bathymetric contours (October 18, 1952).

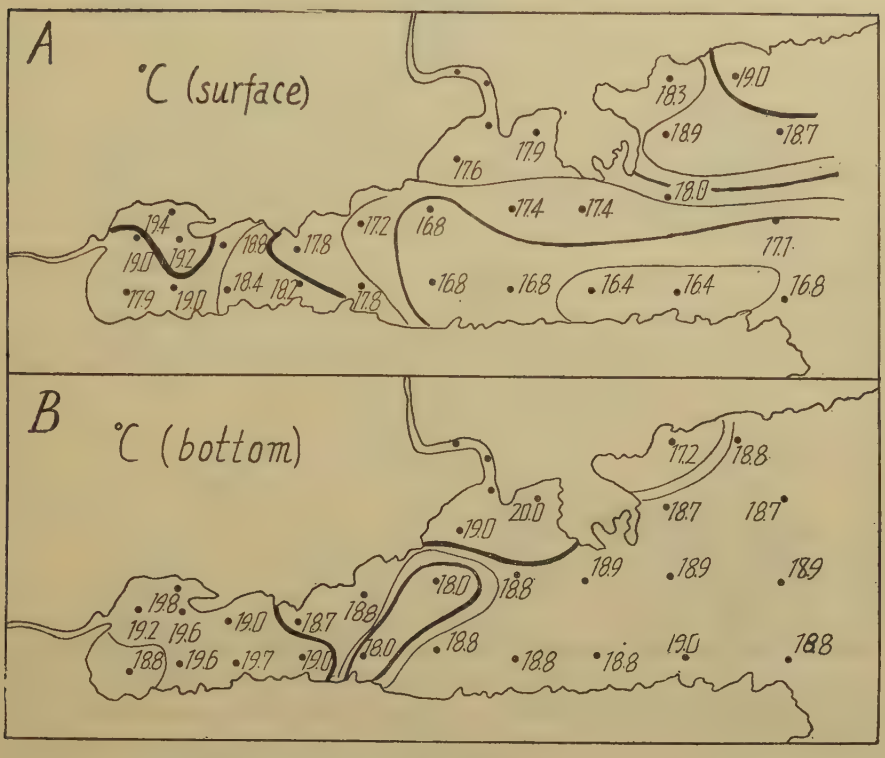

Fig. 2. Distribution of water temperature (°C) at the surface (A) and the bottom (B).

mouth to 19.4°C in the head with a range of 3°C. The bottom water was warmer than the surface. It ranged from 18°C to 20°C, lower in the mouth than in the inner and western part, as in the surface. Such small range of water temperature is a characteristic feature in hydrological conditions of the bay which reflects the direct influence of oceanic influx, due to the topographical simplicity.

Chlorinity (Fig. 3, A and B): The chlorinity of the sea water showed the expected correlation with freshwater discharge. The lowest chlorinity at the surface was found near the estuary of Miyako River, where the discharge pours into the bay and extends widely. The low chlorinity was also found at the innermost part, where a small river pours into. The bottom chlorinity was uniform ranging from 18.5 to 18.6 ‰ except in the narrow area of the innermost part, where the value showed from 16 to 17 ‰.

Transparency and water color (Fig. 4, A and B): The transparency of water was 8-11 m from the mouth to the middle part along the eastern coast. It was very small between the innermost and the estuary of Miyako River, about 2–4 m, and the water was also discolored (No. 7 FOREL's scale).

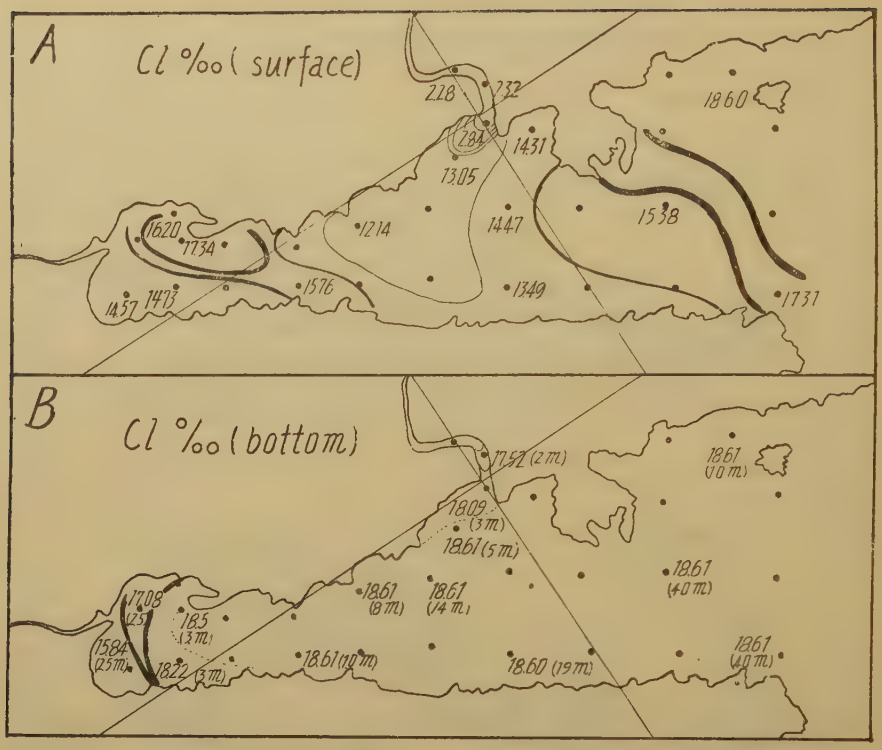

Fig. 3. Distribution of chlorinity in ‰ at the surface (A) and the bottom (B).

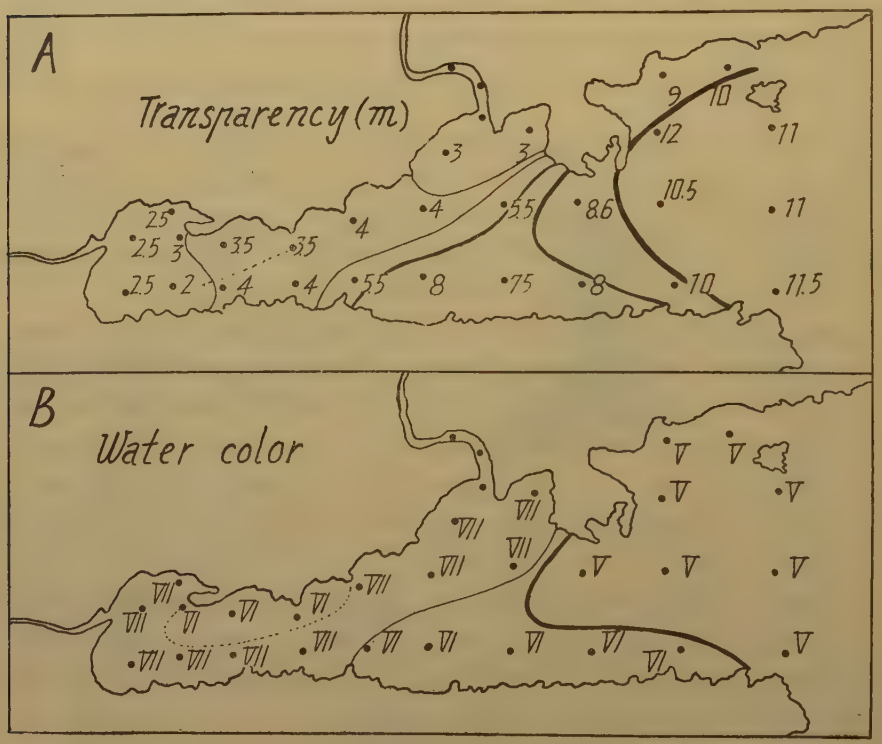
A
Transparency (m)
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Fig. 5. Distribution of silicate content (SiO_2) in mg per m^3 at the surface (A) and the bottom (B).

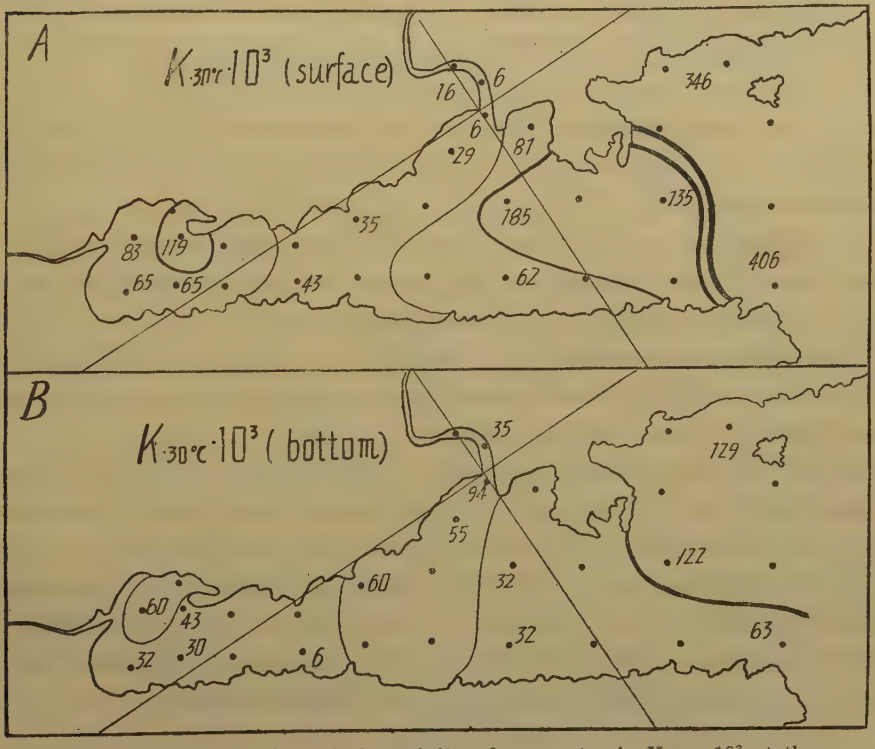

Fig. 6. Distribution of catalytic activity of sea water in $K_{30°C} \cdot 10^3$ at the surface (A) and the bottom (B).

Silicate contents (SiO_2) (Fig. 5, A and B): Silicates (SiO_2 mg/m^3) is a convenient hydrological property for indicating the extent of freshwater discharge and the mixing rate of sea water in correlation with chlorinity distribution. In the surface layer it was generally much larger than that of the subsurface layers except at the shallow basin of the innermost part. The highest silicate content was found near the estuary of Miyako River and next near the estuary of Tugaruisi River. Lower silicates were found in the mouth of the bay.

Catalytic activity of sea water (Fig. 6, A and B): At the surface the catalytic activity of sea water ($K_{30°C} \cdot 10^3$) was higher in the mouth than in the inner part. The lower values were found near the estuaries.

Plankton

A. Quantitative Analysis of Plankton

The plankton samples were vertically hauled from the bottom to the surface. The settling volume and total number are shown in the value per one meter haul in Fig. 7, A and B. These were much larger than those of Onagawa and Kamaisi bays. The value ranged from 0.01 to 0.17 cc and from 15 to 133 thousands of individuals, cells or colonies per one meter haul, respectively. The largest volume and number (about 70–130 thousands) found in the bay were in the middle region (Sts. 7, 9 and 13), and decreased towards the mouth and innermost area (15–20 thousands). The higher number of the inner region is probably due to nutrients plentiful around the estuaries.

The correlation between the settling volume and total number of individuals, cells or colonies is shown in Fig. 9. It is evident that the variability of volume and number are relatively parallel. When the number is small, the volume is generally small too, but there is no decisive correlation thoughout all stations. The irregularities at the mouth (Sts. 19, 21, 25 and 26) are largely due to the poorness of plankton number and the variation of composition.

The total number of zooplankton at each station (Fig. 8, A) was the largest in the inner region, where the number reached 500–1,000 individuals. The population decreased towards the western part of the middle region and attained the minimum in the mouth, where occurred 100–200 individuals. The distribution of phytoplankton population was also similar. The numerical percentage of zooplankton (Fig. 9) in the total plankton was very small, less than 2 %. It generally decreased from the central western region to the inner and the outer region of the bay.

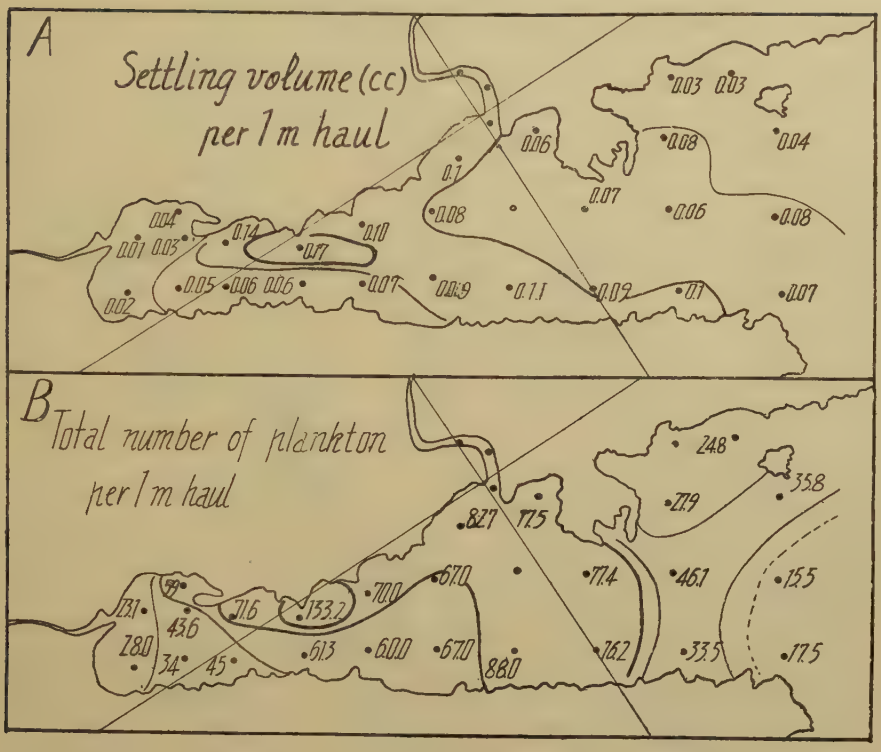

Fig. 7. Settling volume in cc (A) and total number of plankton per one meter haul from the bottom to the surface (Unit of number is thousand).

B. Qualitative Analysis of Plankton

ZOOPLANKTON

As shown in Figs. 8, 10 and 15, the main components of zooplankton were larval forms (25–65 %), protozoans (1–35 %), copepods (5–70 %) and other animals (1–30 %). The distribution of these populations and their percentage composition varied at each station, but they were densest in the inner region and gradually decreased towards the outer region. The number of species was smaller than that of Kamaisi Bay. The higher number of species was found in the outer region than in the inner.

The highest number of copepods occurred in the inner region, but its percentage composition was lower than that in the outer region (Figs. 8, C and 10). The main components of copepods are shown in Figs. 11 and 12. Of these species, *Acartia clausi* was dominant in the inner region. *Oithona nana* and *Euterpe acutifrons* were rather widely distributed from the middle to the inner region but they were sparse in the mouth. *Paracalanus parvus* and *Oithona similis* occurred widely, but relatively rich in the middle region. *Oncaea media* and *Oncaea venusta*, together with *Microsetella norvegica* and *M. rosea*, were restricted to the mouth.

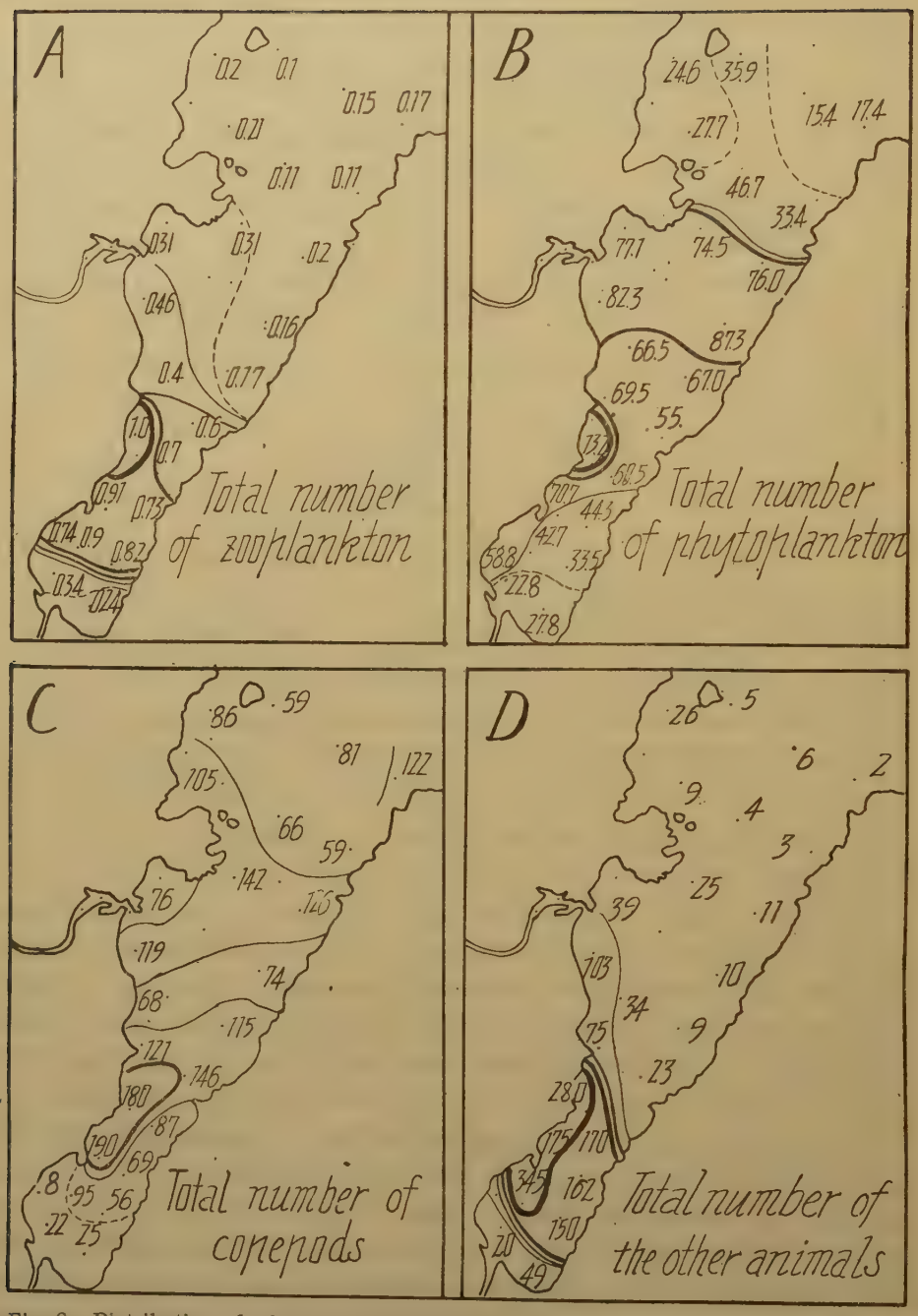

Fig. 8. Distribution of plankton in Miyako Bay.
A. Total number of zooplankton at each station (Unit of number is thousand).
B. Total number of phytoplankton (Unit of number is thousand).
C. Total number of copepods.
D. Total number of other animals than copepods.

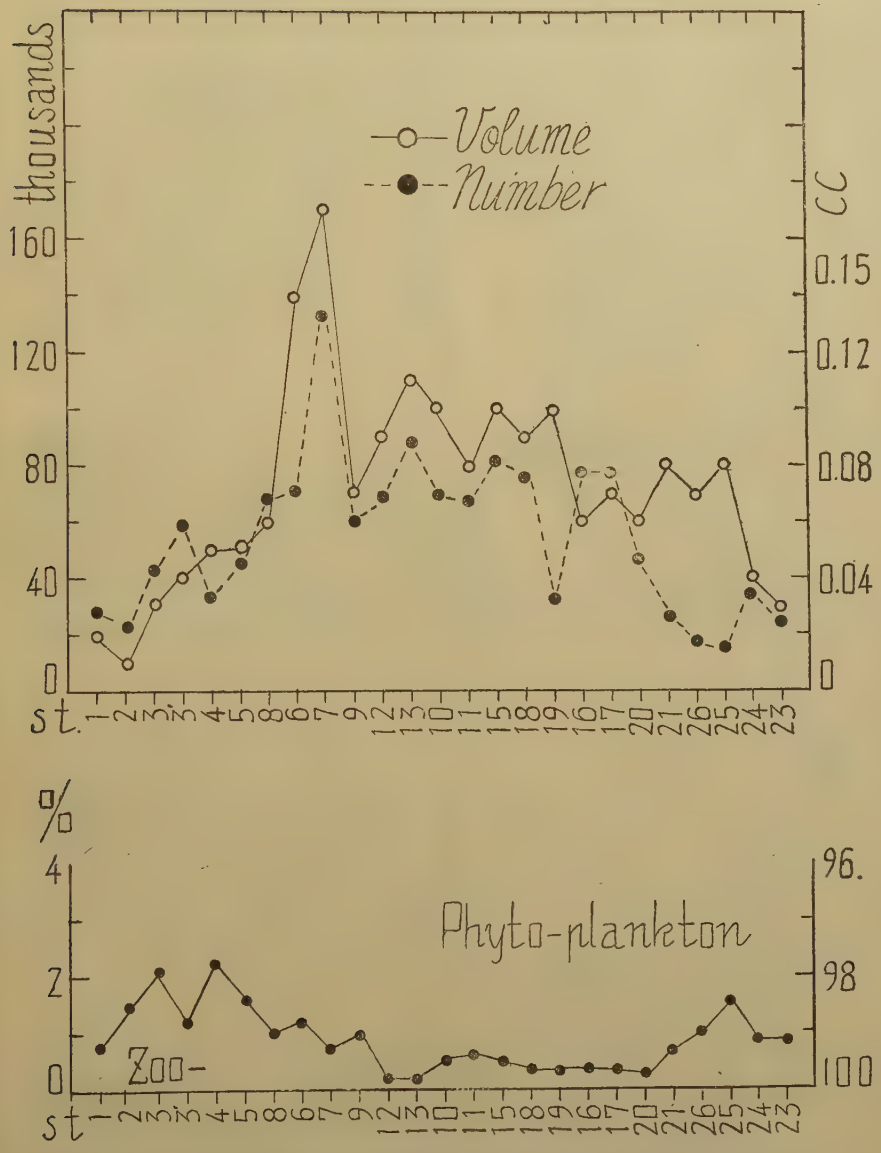

Fig. 9. Correlation between settling volume and total number (top) and percentage composition of zoo- and phytoplankton (bottom).

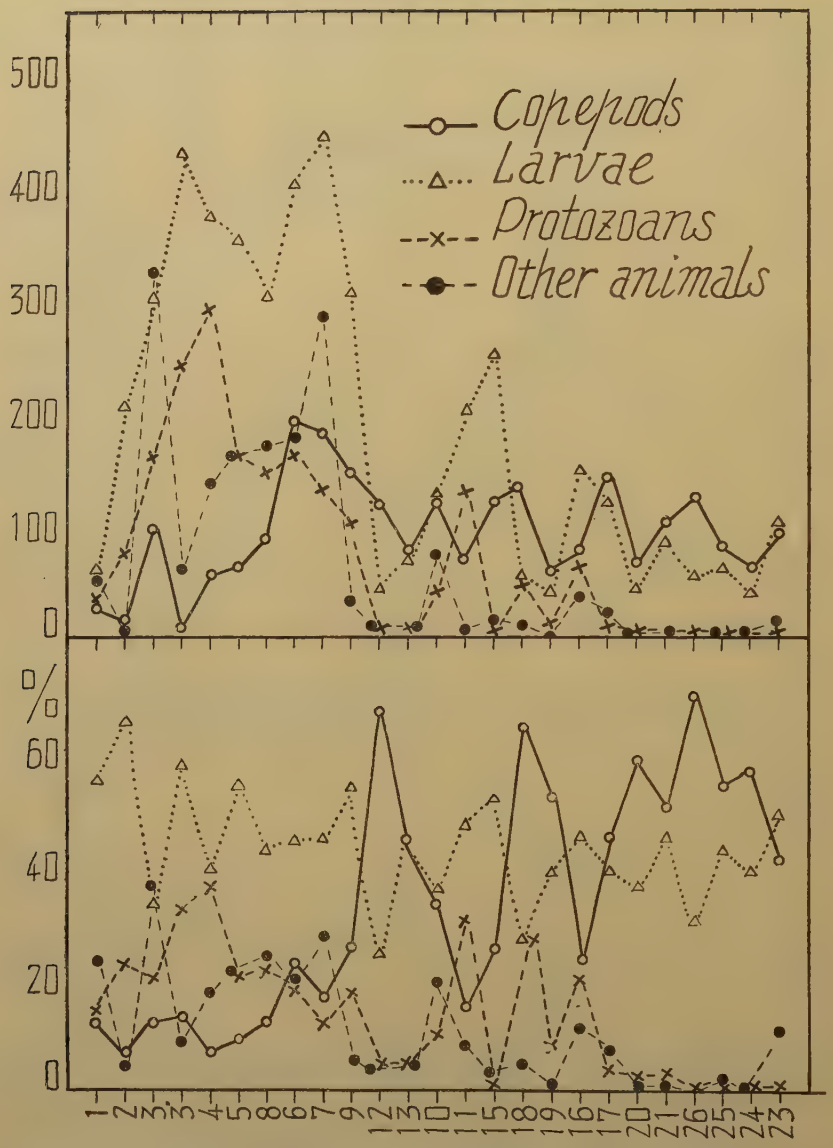

Fig. 10. Number of zooplankton groups per one meter haul (top) and their percentage composition (bottom).

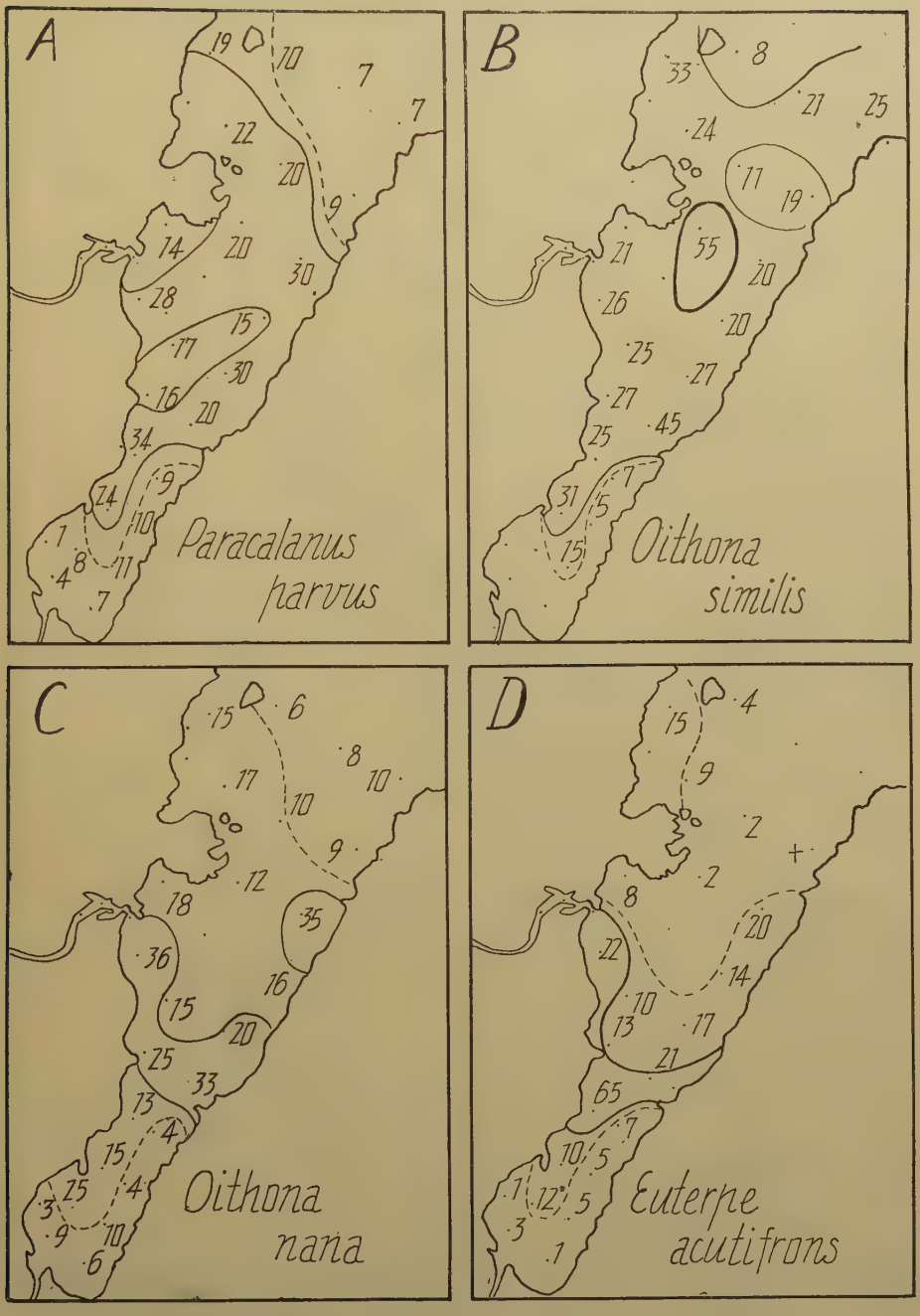

Fig. 11. Distribution of important copepods per one meter haul.

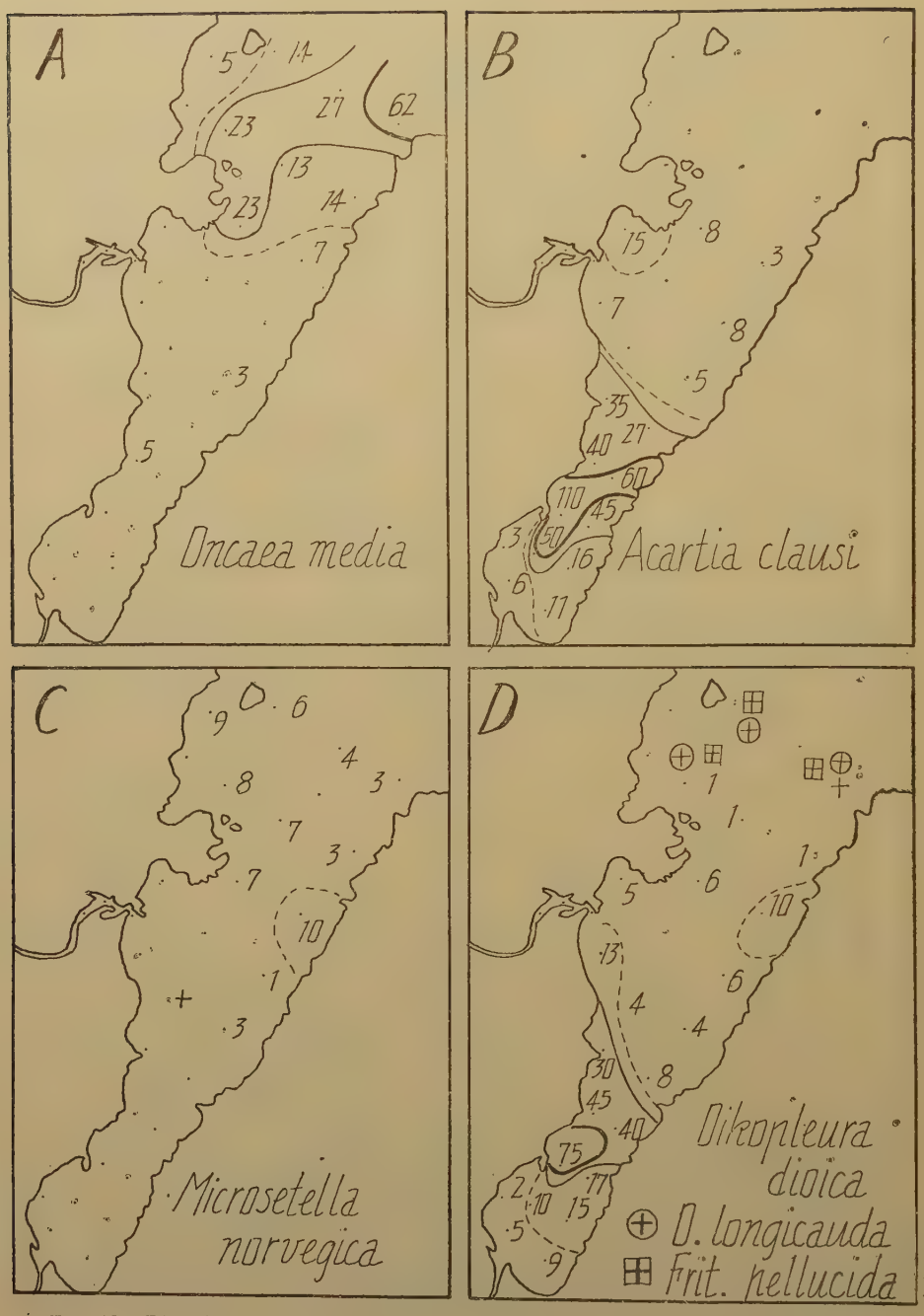

Fig. 12. Distribution of important copepods and tunicates per one meter haul.

As shown in Fig. 13, the percentage composition of these species varies at all stations. In the inner region, *Acartia clausi* was the highest, next *Oithona nana* and the others were much lower. In the middle region, *Oithona nana, Paracalanus parvus, Oithona similis* and *Euterpe acutifrons* were all of similar values, but *Acartia clausi* was much low. In the outer region, *Oithona similis, Oncaea media, Oncaea venusta* and *Paracalanus parvus* showed larger percentages than *Oithona nana* and *Euterpe*, and *Acartia* was not found at all. The offshore copepods, such as *Calanus darwinii, Cal. minor, Cal. tenuicornis, Cal. helgolandicus, Pseudocalanus elongatus, Centropages bradyi, Temora stylifera, Oithona plumifera* and *Corycaeus* sp. were found widely, but very sparsely.

Oceanic chaetognaths *Sagitta minima* and *S. enflata* and oceanic tunicates *Oikopleura longicauda, Fritillaria haplostoma* and *F. pellucida* were found together occasionally in the outer region (Fig. 12, D). Inshore chaetognath *S. delicata* was sparsely found in wide areas. Neritic tunicate *Oikopleura dioica* was found chiefly in the inner region, while very scarce in the mouth (Fig. 12, D). The true inlet rotifer *Encentrum* sp. occurred very abundantly, mainly in the inner region and decreased towards the western part of the middle region (Fig. 15 A).

Among protozoans, tintinnoids were important. *Tintinnopsis radix, Tin. mortensenii, Tintinnus lectus* and *Favella taraikaensis* were predominant in the inner region of the bay. They were not found in the outer region except the first one (Fig. 14).

Copepod nauplii were usually the most abundant of all zooplankton thoughout all stations, mostly in the inner region of the bay (Fig. 15, B). The other larvae, such as those of polychaetes, gastropods and pelecypods, were very scarce everywhere.

PHYTOPLANKTON

Diatoms: The diatoms were very rich in the inner region of the bay. They were characterized by the dominance especially of *Skeletonema costatum* and to a lesser degree, *Chaetoceros* spp. Dominant diatoms in the middle region were different from those in the inner region. The predominant diatoms in the middle region were *Chaetoceros* spp. and to a lesser degree, *Skeletonema costatum, Bacteriastrum hyalinum, Thalassiothrix Frauenfeldii, Thalassionema nitzschioides* and *Coscinodiscus* spp. Among Chaetoceros, *Ch. peruvianus, Ch. decipiens, Ch. Lorenzianus, Ch. didymus, Ch. affinis, Ch. laciniosus, Ch. curvisetus* and *Ch. radicans* were abundant. Small number of *Rhizosolenia* was found in the outer region, but it was fewer in the inner region than in the outer. Oceanic forms, such as *Ch. coarctatus, Ch. densus, Rh. robusta, Rh. calcar avis, Rh. setigera, Rh. alata* f. *indica, Guinardia flaccida, Climacodium biconcavum, Ditylum sol* and *Corethron hystrix* occurred very sparsely in the middle and outer regions of the bay.

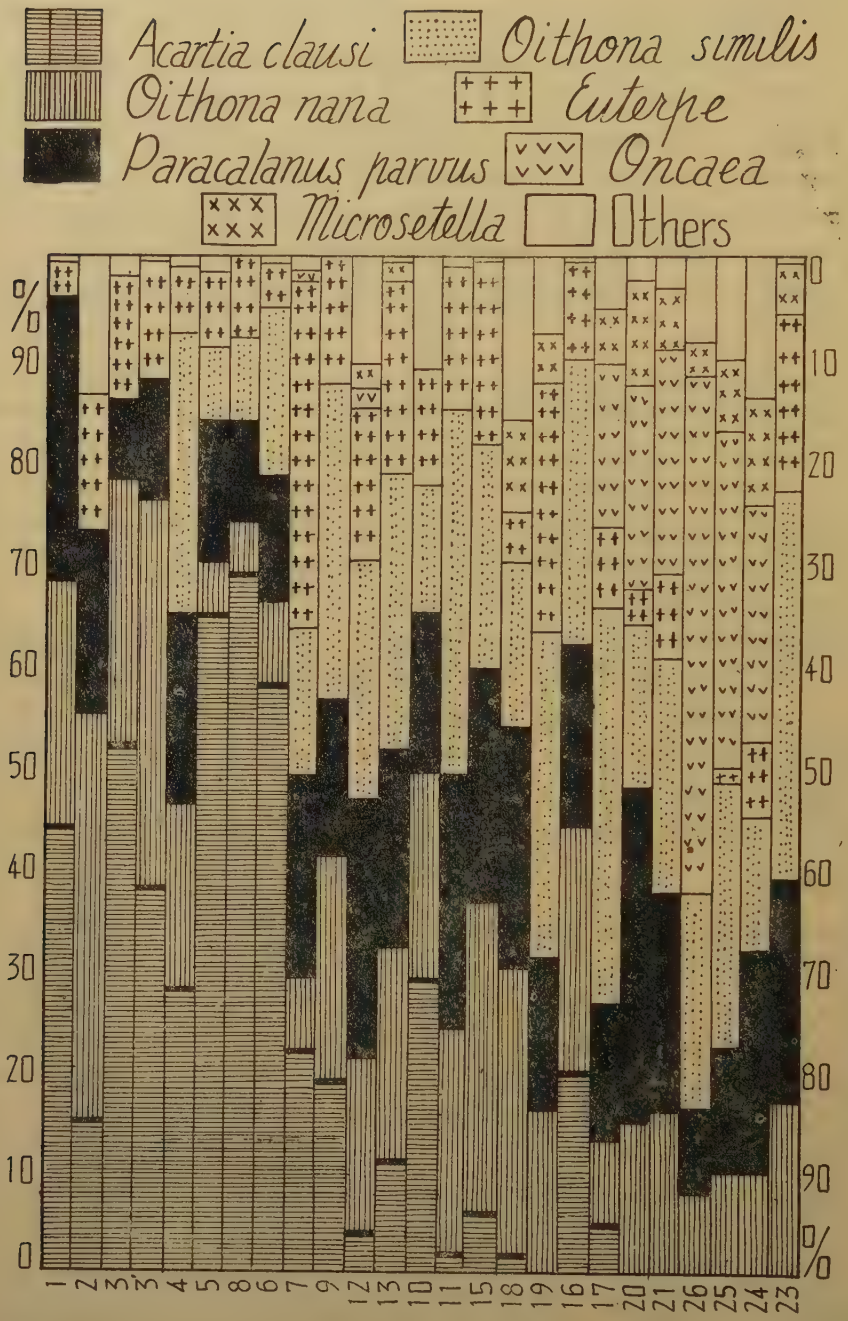

Fig. 13. Percentage composition of important copepods per one meter haul at each station.

Fig. 14. Distribution of important tintinnoids at each station per one meter haul.

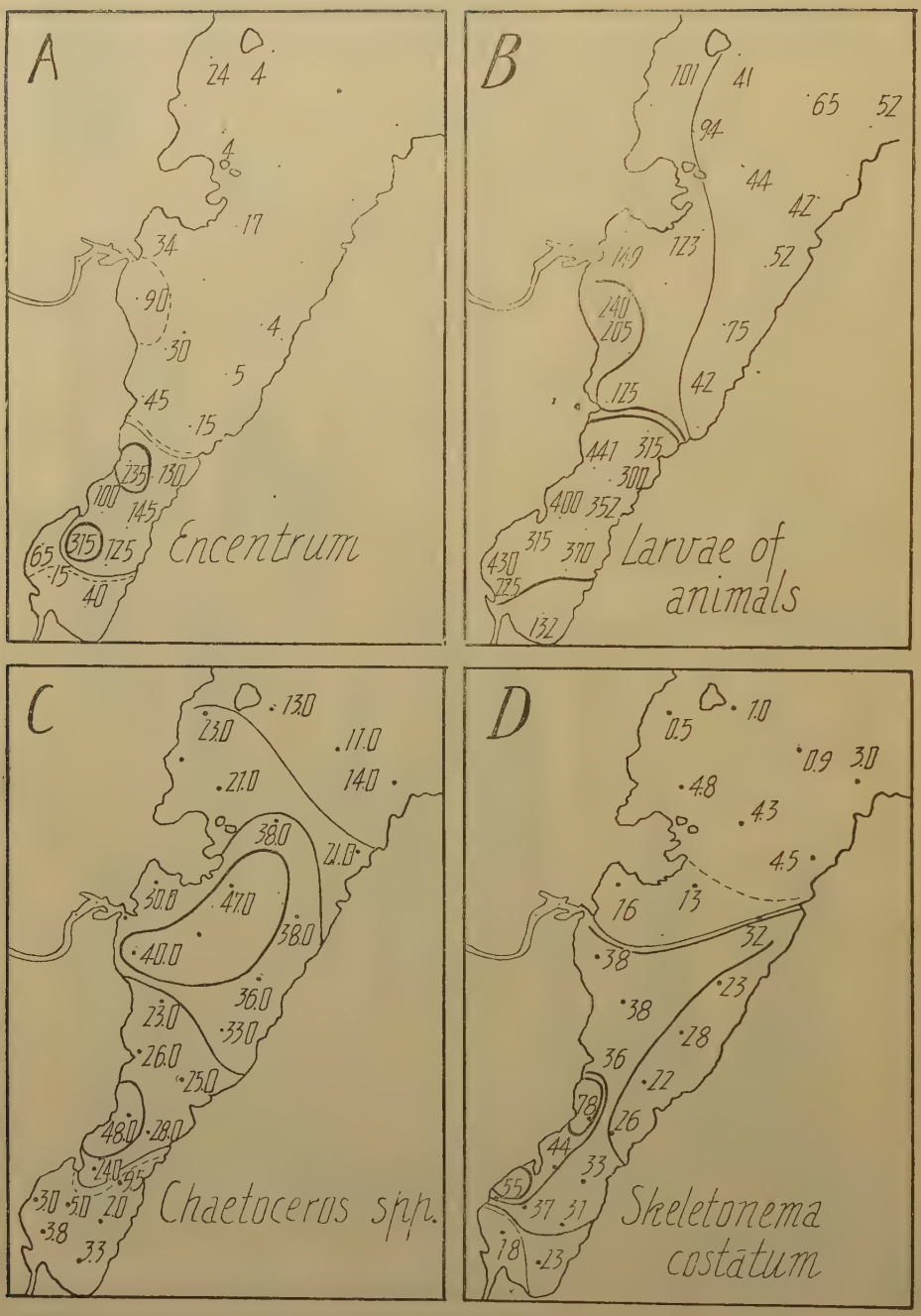

Fig. 15. Distribution of important zoo- and phytoplankton groups at each station. (Unit of number in C and D is thousand).

Dinoflagellates: The dinoflagellates were very scarce in number, although oceanic species occurred in the middle and outer regions. They were *Dinophysis candata, Pyrocystis noctiluca, Ceratocorys horrida, Ceratium tripos* f. *atlanticum, C. candelabrum, C. smatoranum, C. macroceros, C. trichoceros, Cer. molle, C. deflexum, C. masciliense,* etc. However, some species such as *Per. oceanicum* var. *oblongum, Per. conicum, Ceratium fusus* and *Cer. furca* occurred very sparsely in the inner region of the bay.

Consideration and Conclusion

Miyako Bay is a long funnel-like embayment of rias coast characterized by a very deep basin in the mouth which gradually becomes shallower and narrower towards the interior of the bay. The salinity at the surface is low in the inner and western half of the middle region, and at the subsurface layer it is high and relatively uniform except in the inner shallow area at the head. The productivity of the plankton is higher in the inner region than in the outer region. The bay may be divided for convenience' sake into three main regions, the inner, middle and outer, when the distribution of dominant copepods and their associates is taken into consideration (Fig. 16), excepting those of widespread forms showing a rather uniform density of occurrence from the mouth of the bay to the head.

The inner region and the western areas of the middle region are characterized by the abundance of inshore copepods *Acartia clausi* and *Oithona nana*, together with copepod nauplii, *Encentrum* sp., *Oikopleura dioica, Tintinnopsis radix, Tintinnus lectus* and *Favella taraikaensis*. Diatoms such as *Skeletonema costatum* and *Chaetoceros* spp. are also abundant.

The outer region of the bay is characterized by the dominance of *Oncaea media, Oithona similis, Microsetella* and oceanic copepods. The population density of zoo- and phytoplankton is relatively small in the outer region, but the number of species exceeds that in the inner region.

The middle region is intermediate between the inner and outer regions in plankton productivity. *Oithona nana, Paracalanus parvus, Oithona similis* and *Euterpe acutifrons* show almost the same percentage composition respectively. On the other hand, *Chaetoceros* is the most abundant there.

Generally speaking, Miyako Bay as well as the bays of Kamaisi and Onagawa is directly influenced by the open sea water. As the contour of the bay and the bottom condition are comparatively monotonous, the arrangement of plankton communities within the bay seems to be rather typical. All these bays, especially the innermost regions, are more or less different from one another in the topographical, hydrological and planktological conditions. The components of plankton population

Fig. 16. Distribution of dominant copepods in Miyako Bay.

are almost similar, but their numerical abundance and distributional range are not quite similar. The plankton communities of Miyako Bay are rather more allied to those of Onagawa Bay than of Kamaisi Bay, although the differences may be due in part to seasonal variation. For instance, 1) the typical inshore form *Acartia clausi* occurs abundantly in the bays of Miyako and Onagawa, but very sparse in the bay of Kamaisi, and 2) total number of species and offshore forms is fewer in Miyako and Onagawa than in Kamaisi Bay. This may be reasonable since Kamaisi Bay is a comparatively small embayment shorter and wider in extent, and thus better exposed to the influence of the open sea. However, the productivity of diatoms in Miyako and Kamaisi bays is larger than in Onagawa Bay.

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